PB-231 866

USER CHARGES AND INDUSTRIAL COST RECOVERY, DENVER, SMSA (STANDARD METROPOLITAN STATISTICAL AREA)

George H. Aull, Jr., et al

Wilbur Smith and Associates

Prepared for:

Environmental Protection Agency

January 1974

DISTRIBUTED BY:

NTIS

National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

SELECTED WATER
RESOURCES ABSTRACTS
INPUT TRANSACTION FORM

PB 231 866
W74-07370

USER CHARGES AND INDUSTRIAL COST RECOVERY, DENVER SMSA,

G. H. Aull, Jr., T. F. Jones, W. G. Stringfellow
9. Organization

Wilbur Smith and Associates, Denver, Colorado

EPA Contract 68-01-1864

--Environmental Protection Agency, Region VIII, Denver, Colorado, January 1974. 120 p, 2 fig, 52 tab, 42 ref.

--An investigation was made of the extent which wastewater user charges, consistent with current federal regulations and guidelines, have been adopted by municipal and special district wastewater agencies within the Denver Standard Metropolitan Statistical Area. Compliance with these guidelines has been establisned as a prerequisite for award of federal construction grants for wastewater treatment facilities. Three wastewater agencies within the Denver SMSA were selected for more detailed analyses of current user charge schedules. The existing schedules of rates and charges were compared to schedules derived in the study through rational cost allocation and application of model user charge systems developed by Environmental Protection Agency. Volume, strength and flow rates are among the waste characteristics considered in developing cost allocations and revenue structure. Hypothetical examples were also developed to illustrate the possible impact of the industrial cost recovery features of federal regulations and guidelines upon local user charge schedules. A special inquiry was made into the state of eligibility for construction grants of regional wastewater treatment and disposal agencies in the light of revenue methods employed by their direct and indirect subscribers. Possible corrective actions were outlined. Previous study findings were reaffirmed that a number of wastewater agencies within the Denver SMSA have not established or maintained user characteristic and treatment cost data in a form or to the extent necessary to design equitable user charges, and thus fail to comply with current federal guidelines for eligibility for construction grants. (EPA)

--*Pollution taxes (charges), *Cost allocation, Use rates, Treatment facilities, Water rates, *Colorado, *Industrial water, *Regulation, Grants, Cost sharing, Cost repayment, Administrative agencies, Water pollution control, *Construction costs.

--Waste water user charges, Industrial cost recovery, *Denver SMSA

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
U S Department of Commerce
Springfield VA 22151

05D, 06C, 03D, 05G

120
$9.00

Send To:
WATER RESOURCES SCIENTIFIC INFORMATION CENTER
U.S. DEPARTMENT OF THE INTERIOR
WASHINGTON, D.C. 20240

USER CHARGES AND INDUSTRIAL COST RECOVERY

DENVER SMSA

by

George H. Aull, Jr.
Thomas F. Jones
William G. Stringfellow

WILBUR SMITH AND ASSOCIATES
Denver, Colorado 80222

for the

ENVIRONMENTAL PROTECTION AGENCY

Region VIII

Contract No. 68-01-1864

January 1974

EPA REVIEW NOTICE

This report has been reviewed by the Environmental Protection Agency and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

ABSTRACT

This is a report of investigations made of the extent to which wastewater user charges, consistent with current federal regulations and guidelines, have been adopted by municipal and special district wastewater agencies within the Denver Standard Metropolitan Statistical Area. Compliance with these guidelines has been established as a prerequisite for award of federal construction grants for wastewater treatment facilities.

Three wastewater agencies within the Denver SMSA were selected for more detailed analyses of current user charge schedules. The existing schedules of rates and charges were compared to schedules derived in the study through rational cost allocation and application of model user charge systems developed by Environmental Protection Agency. Volume, strength and flow rates are among the waste characteristics considered in developing cost allocations and revenue structure. Hypothetical examples were also developed to illustrate the possible impact of the industrial cost recovery features of federal regulations and guidelines upon local user charge schedules.

A special inquiry was made into the state of eligibility for construction grants of regional wastewater treatment and disposal agencies in the light of revenue methods employed by their direct and indirect subscribers. Possible corrective actions were outlined.

Previous study findings were reaffirmed that a number of wastewater agencies within the Denver SMSA have not established or maintained user characteristic and treatment cost data in a form or to the extent necessary to design equitable user charges, and thus fail to comply with current federal guidelines for eligibility for construction grants.

This report was submitted in fulfillment of Contract Number 68-01-1864 under sponsorship of the U. S. Environmental Protection Agency.

CONTENTS

Section		Page
I	Conclusions	1
II	Recommendations	3
III	Introduction	5
	Study Background and Objectives	5
	Study Area	6
	Scope of Work	7
IV	User Charges within the Denver SMSA	11
	Sewer Service Charges	11
	Sewer Connections by Class of User	14
	Denver Industrial Waste Program	16
V	Specific Analyses of User Charges	21
	User Charges	21
	Effluent Parameters	22
	North Washington Street	25
	North Table Mountain	42
	Arvada	59
VI	Industrial Cost Recovery	69
	Recovery of Grant Funds	69
	Hypothetical Example for Recovery of Grant Funds	71
	Relating Example to Local District	76
	Industrial Allocation of Capital Grant Recovery Charges	86
VII	Prerequisites to a User Charge System	95
	Public Acceptance	95
	Industrial Data	95
	Accounting and Cost Allocation	96
	User Charge Schedule	97
	Adopting Ordinance	98
	Operating and Management Plan	98
	Plan Update	99
	Transitional Steps	100
VIII	Regional Wastewater Agency	101
IX	Acknowledgements	103
X	References	105
XI	Bibliography	107
XII	Glossary	111
XIII	Appendices	115

Preceding page blank

FIGURES

		Page
1	Wastewater Service Area Denver SMSA	8
2	Industrial Rate Calculation Formula, North Washington Street Water and Sanitation District	37

TABLES

No.		Page
1	Sewer Service Charges - Selected Municipalities and Sanitation Districts - 1972	12
2	Sewer Connections by Type of User - Selected Municipalities and Sanitation Districts - 1972	15
3	City of Denver Industrial Categories - 1971	18
4	Effluent Flow Per Tap - Selected Sanitation Districts - 1972	23
5	Effluent Content - Selected Sanitation Districts - 1972	24
6	Calculation of Base Domestic Flow, Biochemical Oxygen Demand and Suspended Solids - Selected Municipalities and Sanitation Districts - 1972	26
7	Calculation of Base Domestic Flow, BOD and SS - Selected Municipalities and Sanitation Districts - 1972	27
8	Calculation of Base Domestic Flow, BOD and SS	28
9	Comparison of Tons of Domestic Content Level - Study Municipalities and Sanitation Districts	29
10	Sewage Costs by Function - North Washington Street Water and Sanitation District - Year Ended November 30, 1972	31
11	Calculation of Total and Unit User Charges by Function - Based on MDSDD #1 Allocation Formula - North Washington Street Water and Sanitation District - 1972	32
12	Calculation of Total and Unit User Charges by Function - Based on WS&A Allocation Formula - North Washington Street Water and Sanitation District - 1972	33
13	Calculated and Actual Charges for Measured Industries Using MDSDD #1 Allocation North Washington Street Water and Sanitation District - 1972	35

No.		Page
14	Calculated and Actual Charges for Measured Industries Using WS&A Allocation - NWSW&SD - 1972	36
15	Applicable Charge Per 1000 Gallons Flow with Base Effluent Content - NWSW&SD - 1972	38
16	Estimated Flow and Loadings by All Users NWSW&SD - 1972	40
17	Estimated and Actual Charges by All Users NWSW&SD - 1972	41
18	Sewage Costs by Function - North Table Mountain Water and Sanitation District Year Ended November 30, 1972	44
19	Total and Unit User Charges by Function Based on MDSDD #1 Allocation Formula - NTMW&SD - 1972	45
20	Total and Unit User Charges by Function Based on WS&A Allocation Formula NTMW&SD - 1972	46
21	Estimated Flow and Loadings by All Users NTMW&SD - 1972	48
22	User Share of System Load Based on Estimated Loadings (Table 21) - NTMW&SD - 1972	49
23	Adjusted Flow and Loadings Based on Estimated Share Allocation (Table 22) - NTMW&SD	50
24	Calculated and Actual Charges for Measured Industries Using MDSDD #1 Allocation- NTMW&SD - 1972	52
25	Calculated and Actual Charges for Measured Industries Using Revised (WSA) Allocation - NTMW&SD - 1972	53
26	Adjusted Annual Flow Quantities Based on Allocated Usage (Table 23) - NTMW&SD - 1972	54
27	Adjusted BOD and SS Levels Based on Allocated Usage by User Class - NTMW&SD - 1972	55

No.		Page
28	Applicable Charge Per 1,000 Gallons Flow Based on Adjusted Effluent Content and Revised Flow Allocations - NTMW&SD - 1972	57
29	Estimated and Actual Charges by All Users - NTMW&SD - 1972	58
30	Total Flow and Loadings - City of Arvada - 1972	60
31	Sewage Costs by Function - 1972	62
32	Calculation of Total and Unit User Charges - by Function - Arvada Wastewater Control - 1972	63
33	Calculation of Total and Unit User Charges By Function - City of Arvada - 1972	64
34	Applicable Charge Per 1000 Gallons Flow With Base Effluent Content - City of Arvada - 1972	65
35	Estimated and Actual Charges by User Class - City of Arvada	67
36	Determination of Allowable Costs and PL 92500 Grant - Example of Treatment Facility Capital Costs Chargeable to Industrial Users	72
37	Eligible and Ineligible Project Cost Items Total and Grant Portion - Example of Treatment Facility Capital Costs Chargeable to Industrial Users	73
38	Grant Project Items Allocated to Flow, BOD and SS (Example)	74
39	Assumptions - Example of Treatment Facility Capital Costs Chargeable to Industrial Users	75
40	Grant Recovery From Industry - Example of Treatment Facility Capital Costs Chargeable to Industrial Users	77
41	Current and Assumed System - NTMW&SD	78
42	Future Industrial Users Assumed Effluent Levels	80

No.		Page
43	Assumed Costs by Function - NTMW&SD - (in 1972 dollars)	81
44	Assumed Total and Unit User Charges - NTMW&SD	82
45	Calculated Charges for Industries Based on Assumed Conditions - NTMW&SD	83
46	Applicable Charge Per 1,000 Gallons Flow Based on Content and Flow Assumptions NTMW&SD	84
47	Estimated Charge for All Users Based on Assumed Conditions - NTMW&SD	85
48	Existing Industrial Users-Assumed Future Effluent Levels - Year 1	88
49	Allocation of Capital Grant Recovery Three "Existing" Industries - Year 1 (Annual Charge)	89
50	Future Industrial Users-Assumed Effluent Levels - Year 2	90
51	Allocation of Capital Grant Recovery - Seven "Future" Industries - Year 2 (Annual Charge)	91
52	Hypothetical Cost Recovery Schedule - Industrial Allocation	93

SECTION I

CONCLUSIONS

1. A basic non-compliance with EPA guidelines exists within many jurisdictions because of the initial financing mechanisms and current financial practices.

2. Accounts classification and cost allocation systems of many wastewater agencies are totally inadequate as bases for formulating equitable user charges.

3. User classification systems are poorly developed. The Standard Industrial Classification Manual system (SIC) is not broadly applicable to individual users and is difficult to apply. Loading characteristics vary greatly between industries, even of the same type.

4. While not all agencies have industrial users, very few are staffed and equipped to administer an industrial waste program. As a consequence, user characteristic data is currently not available in most instances.

5. An opportunity exists for cooperative or joint action in formulating and implementing industrial waste programs.

6. The continuing eligibility of Metropolitan Denver Sewage Disposal District No. 1 (MDSDD #1) to receive Federal construction grants is threatened because not all of its direct or indirect subscribers have established equitable industrial user charges.

7. The content and implications of User Charge and Industrial Cost Recovery guidelines is not widely understood by wastewater agencies.

8. Sewer service charges to customers outside the district may be higher than charges to customers inside the district <u>only</u> if additional costs are actually incurred to serve those customers.

SECTION II

RECOMMENDATIONS

1. The State of Colorado should promulgate a uniform system of accounts and cost allocation methods for wastewater functions for all public wastewater agencies within the State.

2. The Denver Regional Council of Governments or MDSDD #1 should sponsor seminars or training classes in the classification and maintenance of accounts, cost allocations, requirements of EPA Regulations and Guidelines, and establishment of industrial waste programs.

3. The Metropolitan Denver Sewage Disposal District No. 1 Service Contract should be amended by voluntary action of the members, or by State legislation, to require the enactment and maintenance of equitable wastewater user charges by all subscribers.

4. MDSDD #1 should consider providing contractual staff services to its subscribers in accounting, billing, rate review, sampling and testing programs, etc., on a service bureau basis.

5. The EPA should permit and assist in development of a staged approach to compliance with guidelines to achieve optimum results.

6. When possible, the emphasis should be placed on user rather than user class in developing charge schedules.

Preceding page blank

SECTION III

INTRODUCTION

Study Background and Objectives

Under date of April, 1973, the U. S. Environmental Protection Agency, Region VIII, issued the report Financial and Institutional Arrangements for Wastewater Management - Denver SMSA, covering sixteen wastewater agencies. Among the findings of that study was that certain of the wastewater agencies did not systematically maintain operating and financial records or procedures to insure that cost burdens were being equitably apportioned among the various users or user classes.

The previous study noted that there are currently more than one hundred agencies within the Denver SMSA which provide sewage collection and/or treatment and disposal. These range from very small sanitation districts, performing collection only, to the large Metropolitan Denver Sewage Disposal District No. 1 (MDSDD #1) which provided treatment and disposal for the wastes generated by 22 member agencies which serve a population of almost one million persons. The extent of inter-agency agreements for wastewater handling is substantial.

The subsequent issuance by the Environmental Protection Agency of regulations and guidelines on user charges and industrial cost recovery[1] has raised questions and considerations as to the extent of compliance by wastewater agencies in the Denver SMSA, the means by which compliance might be achieved, and the implications upon the eligibility of regional treatment and disposal agencies for federal grants for construction of treatment works.

This current study is designed to determine the degree and extent of compliance by selected wastewater agencies with EPA rules and regulations regarding user charges and industrial cost recovery, (and thus the eligibility for construction grants). The implications of this inquiry go beyond the concern for the practices of the individual agencies. MDSDD #1, for example, receives the wastes of 22 member agencies, many of whom also receive and transmit wastes from other originating agencies. Literally translated, the regulations and guidelines restrict the eligibility of MDSDD #1 to receive needed construction grants without compliance with those rules and regulations by all direct and indirect subscribers.

This study, then, is an extension of the previously-cited

Preceding page blank

study in order to ascertain the extent of compliance with the rules and regulations and their impact upon financial and institutional arrangements for wastewater management in the Denver SMSA.

Study Area

The study area, which is coterminous with the Denver Standard Metropolitan Statistical Area, consists of 3,661 square miles within five urban counties including and surrounding the City and County of Denver, Colorado, namely, Adams, Arapahoe, Boulder, Jefferson and Denver. The area is a dynamic, rapidly-expanding area with many of the problems and opportunities which confront an area with rapid population and economic growth.

In 1970 approximately 1,227,529 persons resided in the five county area, which represented 55.6 percent of the total population of the State of Colorado. The study area's population doubled between 1950 and 1970. This growth accounted for 70 percent of the population growth of the State during this period. Estimates made by many different agencies indicate that the Denver SMSA's growth is expected to continue for quite some time. For example, a reasonable estimate of future growth might be that as projected for the Regional Transportation District which projects the 1990 population to be 1,818,000, an increase of approximately 30,000 persons annually.

Corresponding to this rapid population growth has been an increase in the number of public and quasi-public agencies charged with the provision of public services required by the expanding population. In fact, the area has witnessed a proliferation of such agencies to the point that there are frequent instances of overlapping boundaries and jurisdictions, duplication of efforts, and lack of clarity as to authority and scope.

There are forty-four incorporated municipalities in the metropolitan area, most of which provide and maintain their own sewer systems. In addition, there are 238 special purpose districts (excluding school districts). A majority of these special purpose districts are sanitation, water, or water and sanitation districts.

The Denver metropolitan area has expanded in the pattern fashioned by most other urban areas. Development patterns are the traditional ones, with a commercial/ industrial city center, residential suburbs and, presently, the development of shopping centers and other decentralized facilities outside of the center city. As the area has developed, an extensive system of sewers has evolved which covers most of the developed areas and which is

administered by a great many autonomous and semi-autonomous agencies.

Some bypassing of vacant lands has occurred. This has had some impact upon the cost of public services, such as sewer collection, interceptor or pumping costs. This may be of increasing concern as development extends into outer reaches of the study area.

Population growth and, consequently, land use, is expected to continue much as it has in recent years. The areas adjacent to Denver will undergo substantial residential development, particularly to the south, southeast, southwest, and north. Growth in these areas already is occurring and little is anticipated to hinder development in these directions. This study has sampled wastewater agencies in several of these growth areas, as well as in areas that have not been expanding.

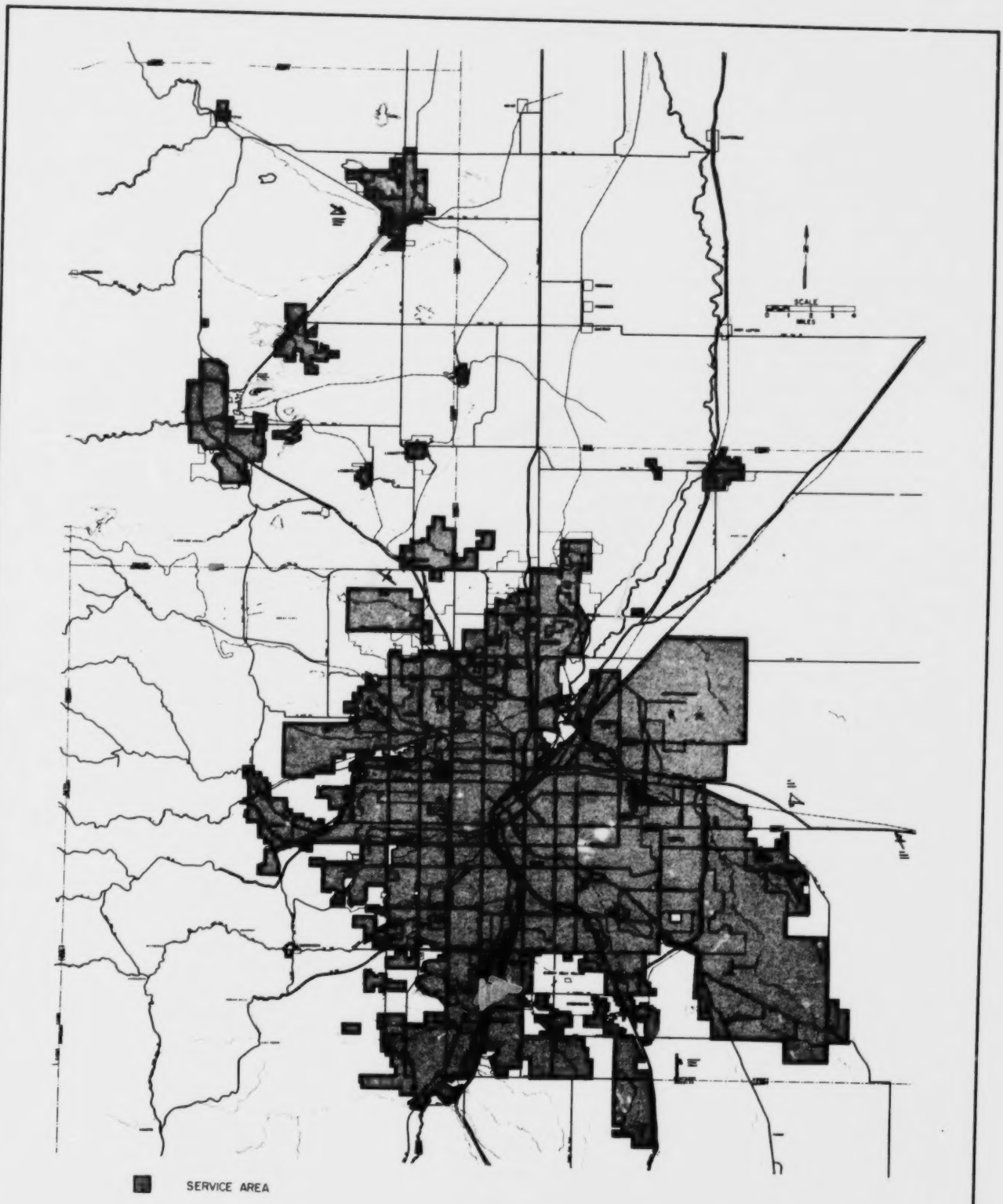
Scope of Work

The scope of work involved the review of data compiled in the preceding study for 16 wastewater agencies, the collection of similar data on all MDSDD #1 members not previously investigated, and detailed analyses of the current practices of 3 agencies [2] with respect to requirements for compliance with regulations and guidelines for user charges and industrial cost recovery. Figure 1 shows the wastewater service area within the Denver SMSA. However, only those agencies subscribing to service from MDSDD #1 were included in this investigation.

Considerable attention was focused on the financial, legal and physical arrangements necessary to achieve compliance. Special inquiry was made into the effect upon eligibility of MDSDD #1 as a result of the practices of its subscribers.

The investigations involved consultations with numerous officials of wastewater agencies and the Environmental Protection Agency and extensive literature research. In performing the calculations and analyses, it was frequently necessary to develop assumptions; where this was necessary, the best sampling of available advice and experiences was sought.

The level of effort designed for this study was geared to the use of available data and did not include provisions for wastewater testing, detailed cost of service analyses, or requirements to define and establish model wastewater flow and contribution criteria (i.e., levels for normal domestic sewage). This report is intended to provide general procedural steps and methods by which the user charge and capital cost recovery guidelines can be applied.



WASTEWATER SERVICE AREA
DENVER SMSA

Wilbur Smith and Associates SOURCE: DENVER REGIONAL COUNCIL OF GOVERNMENTS

FIGURE 1

It should be emphasized that many cost allocations, flow volumes, strength concentrations and other factors are general averages or are based on assumptions. Where this was necessary, the most appropriate available data, advice and experience were used. However, these assumed allocations and factors will vary considerably from district to district and area to area. If anything can be stressed from this, it is that all pertinent factors must be analyzed by each district and accurate values determined for use in this program. The use of inaccurate variables or inconsistent assumptions can greatly affect the equitability and application of this program.

SECTION IV

USER CHARGES WITHIN THE DENVER SMSA

Sewer Service Charges

A primary purpose of this study is to identify the means by which various wastewater agencies within the Denver SMSA levy service charges upon industrial users. In the previous study, 9 municipalities, 6 sanitation districts and MDSDD #1 were sampled. For this study, each of these agencies was again contacted and data contained in the previous study were brought up to date. To provide a broader data base, two additional municipalities and 12 additional districts were contacted. Sewer service charge data for the 29 agencies are presented in Table 1.

Municipal Agencies - All of the municipal agencies sampled charge a specific fee for supplying sewer service to their users. These fees vary from municipality to municipality and according to the class of user. Residential users are generally charged on a per-unit fixed fee basis, or a percentage of the water bill, or a combination of both.

Municipal commercial user schedules are generally more responsive to demand as necessitated by the heterogeneity of this class of user. In most municipalities, commercial users are charged based on a percentage of the water bill or on the volume of use. In some cases, commercial users are charged on a flat rate based on potential water usage or according to the number of contributing fixtures.

Although some wastewater agencies either have no industrial users or do not classify them separately from commercial users, each of the municipalities sampled has a procedure established for determining industrial user charges. As with commercial rates, Denver, Thornton and Westminster establish rate schedules or negotiated contracts based on flow and loadings. Aurora does provide for negotiated contracts with industrial users but has none so classified at this time and has established no basis for negotiated charges.

Sanitation Districts - Sanitation, or combined water and sanitation districts are generally much smaller in terms of the number of users and exhibit a much wider variety of methods for determining user charges. In 9 of the 19 districts, residential users are charged on a per unit basis. Mill levies (ad valorem property taxes) are used as the means of user charge in 4 districts, and a combined unit charge and mill levy is used in 3 districts. One

Preceding page blank

Table 1

SEWER SERVICE CHARGES
Selected Municipalities and Sanitation Districts
1972

JURISDICTION	BASIS OF SERVICE CHARGE			TYPICAL MONTHLY SERVICE CHARGE Residential(a)	
Municipalities	Residential	Commercial	Industrial	In District	Outside District
Arvada	Per Unit	Meter Size	Meter Size and Type of Discharge	$2.23	$4.03
Aurora	Per Unit	Water Consumption	None	1.50	3.00
Boulder	Per Unit plus per Water Use	Meter Size plus per Water Use	Meter Size plus per Water Use	2.75	4.12
Broomfield	Per Unit	Per Unit plus percent of Water Bill	Per Unit plus percent of Water Bill	3.50	3.50
Denver	Percent of Water Bill(b)	Percent of Water Bill(b)	Type and Amount of Discharges	3.25	3.08
Englewood	Per Unit	Number of Fixtures	Percent of Water Bill	1.25	1.75
Golden	Per Unit plus per Water Use	Water Consumption	Water Consumption	1.50	3.00
Littleton	Percent of Water Bill	Meter Size	Meter Size	2.25	2.70
Longmont	Percent of Water Bill	Percent of Water Bill	Percent of Water Bill	3.70	7.40
Thornton	Per Unit	Percent of Water Bill	Negotiable Contract	3.50	3.50
Westminster	Per Unit	Per Water Use	Negotiable Contract	3.00	3.50
DISTRICTS					
Alameda	Mill Levy	Water Consumption	No Schedule	NA	
Applewood	Mill Levy	Water Consumption plus Mill Levy	Water Consumption plus Mill Levy	NA	
Bancroft	Included in Water Bill and Mill Levy	Water Consumption	Water Consumption	NA	
Berkeley	Per Unit	Number of Fixtures	Number of Fixtures	3.00	
Brighton	Per Unit	Variable by Type(d)	Contract	3.00	
Crestview	Per Unit plus Mill Levy(c)	Percent of Water Bill with Minimum Charge	Based on MDSDD#1 Charges plus 30 Percent	2.00	4.00
East Lakewood	No Charges	None	None		
Fruitdale	Per Unit plus Mill Levy	Per Unit	Fixture Units(e) or Percent of Water Bill, or Negotiated	2.00	
Highland Park	Mill Levy(f)	Per Unit	Established by District Board		
Lafayette	Per Unit	Per Unit or Percent of Water Bill	Percent of Water Bill	3.00	
North Pecos	Per Unit	Number of Fixtures or Percent of Water Bill	Number of Fixtures or Percent of Water Bill	3.00	
North Table Mountain	Per Unit(g)	Percent of Water Bill	By Contract	4.00	
North Washington Street	Per Unit	Number of Fixtures	Several Methods: (1)Number of Facilities (2)Water Usage (3)Type and Amount of Discharge (4)Contract		
North West Lakewood	Per Unit plus Mill Levy	Fixture Examination(h)	Fixture Examination(h)	1.50	
Pleasant View	Per Unit	Fixture Examination(h)	Fixture Examination(h)	2.00	
South Adams	Per Unit	Water Consumption	Water Consumption	2.00	
Westridge	Mill Levy	Mill Levy	Mill Levy	NA	
Wheatridge	Per Unit	Water Consumption	None Established	1.00	2.00

(a) Assumes 7,000 gallons of water per month in winter; 10,000 gallons per month average.
(b) Percent of water bill if inside city; per gallon or per unit if outside of city.
(c) Percent of water bill for hotels and motels. If water received from other sources rate is $1.50 per unit per month for hotels and motels with differential rates set up for other commercial users.
(d) Depending on the type of user charge may be based on facility, number of units, composition of effluent, or as a percent of water bill.
(e) Unit has 19 fixtures.
(f) Per unit for multi-family with equivalencies determined independently in each case.
(g) Multi-family, commercial and small industrial as a percent of water bill.
(h) Examination of quantity and type of contribution to system plus mill levy.

district (Bancroft) has a combined water-sewer bill as well as a mill levy, and one (East Lakewood) makes no charge on its users. In those districts where a typical monthly rate could be determined, charges ranged from a low of $1.00 (North Washington Street and Wheatridge) to $4.00 (North Table Mountain).

Determination of commercial user service charges in the sanitation districts varies considerably in method when compared to the municipal charge structures. One district (Brighton) bases its charge on the type of user and, in some cases, may sample effluent content. This is the only district currently employing such procedures. Within the remaining 17 districts, 8 different methods for determining commercial service charges were found. Most common is a charge based on water usage or billing (6 districts). A charge based on the number and type of fixtures is used in 4 districts, and a unit charge is levied in 2 districts. The remaining 5 districts each employ a unique scheme of commercial user charges as shown in Table 1.

A means of determining industrial user charges has not been established in 3 districts. In those districts with established methods of determining industrial user charges there is, as with commercial users, a great deal of variation. Charges based on water consumption are used in 3 districts, and charges based on the number of fixtures in 3 districts. Negotiated contract is the method used by 2 districts. Three districts use a variety of methods depending on the type of user. A mill levy is used by one district, charges are established on an individual basis by the district board in another, and one district bases its charges on the MDSDD #1 charges.

Summary - From the foregoing it is apparent that there is no standard, universally applicable method utilized for user service charge determination. Nevertheless, the per unit charge or mill levy, which is commonly applied to residential users, would be equitable only so long as (1) residential users are relatively homogeneous in terms of system demand; (2) revenues cover the costs of serving residential users; and (3) residential properties do not cover a wide range of valuation.

Service charges for commercial and industrial users are not generally levied on a flat rate basis, which indicates recognition of the equity and the necessity of charging these users on a basis bearing some relationship to the flow and loadings placed on the sewerage system. An important aspect of this study is the review of the industrial rates used by selected agencies and their relationship to costs actually incurred in the treatment of industrial wastes.

Sewer Connections by Class of User

To further inventory the characteristics of the various sanitation districts in the metropolitan area, each of the 16 agencies investigated in the original study was again contacted in order to ascertain any changes in the number of users by type or class. Two additional municipalities and twelve additional sanitation districts were investigated. This represents a significant expansion of the data base for the extended study. Number of users by class is shown in Table 2.

Traditionally, three distinct types of users are identified for classification and ratemaking purposes: "residential," "commercial" and "industrial." Occasionally, "public" or "institutional" is cited as a fourth category, but in most cases these users appear to fall under the residential and/or commercial classifications. Classification of users is usually based on structure use. For example, a living place would be residential, retail or wholesale facilities or office buildings would be commercial, and industrial might cover all forms of industry -- light and heavy. Classification is occasionally on land use or the zoning category of the property. In many cases the classification is judgmental and is thus susceptible to wide ranges of interpretation and, of course, error.

It is also possible for a classification of user (i.e., hospital)to be included as an "industry" for purposes of levying a user charge because of atypical discharge characteristics, but to be classified as commercial/ institutional for purposes of capital grant recovery and thus not required to participate in grant repayment.

Because wastewater collection, treatment and disposal are responsive to flow and loadings, a different classification scheme, or the development of more appropriate classification criteria may be required. Ideally, such a classification scheme should provide the local wastewater agency with an immediate reference as to the impact of a specific facility on the local sewerage system and treatment works. Obviously, the only way to know the contribution of each user is to measure the contribution of each user. Such an approach is frequently both impractical and unnecessary. It may be impractical simply from the logistics and cost involved. It may be unnecessary for all users because the majority of users are usually dwelling units with relatively homogeneous sewage characteristics. Within defineable statistical bounds, it should be possible to estimate the average domestic flow and loadings of these units. What is needed is a means of identifying the unusual user -- the one who contributes at a rate (either content or flow) exceeding that of the domestic user.

Table 2

SEWER CONNECTIONS BY TYPE OF USER
Selected Municipalities and Sanitation Districts
1972

MUNICIPALITIES	NUMBER OF TAPS						TOTAL
	Residential		Commercial		Industrial		
	Number	Per Cent	Number	Per Cent	Number	Per Cent	
Arvada	15,218	97.5	372	2.4	17	0.1	15,607
Aurora	NA	-	NA	-	NA	-	23,000
Boulder[a]	14,627	91.8	1,100	6.9	200	1.3	15,927
Broomfield[a]	3,686	97.0	103	2.7	11	0.3	3,800
Denver	110,229	85.5	18,520	14.4	121[d]	0.1	128,870
Englewood	22,693	93.3	1,630[c]	6.7	-[c]	0.0	24,323
Golden	2,987	93.8	163	5.1	35	1.1	3,185
Littleton	NA	-	NA	-	2	0.0	8,200
Longmont	7,962	93.3	573	6.7	-[c]	-	8,535
Thornton	15,297	97.1	454[c]	2.9	-[c]	0.0	15,751
Westminster[a]	5,402	96.4	202	3.6	1	0.0	5,604
DISTRICTS							
Alameda	2,650	99.3	19	0.7	0	0.0	2,669
Applewood	708	100.0	0	0.0	0	0.0	708
Bancroft	5,084	98.5	76	1.5	0	0.0	5,160
Berkeley	50	98.0	1	2.0	0	0.0	51
Brighton[a]	2,437	89.1	297	10.9	0	0.0	2,734
Crestview	4,310	95.0	225	5.0	1	0.0	4,536
East Lakewood	296	100.0	0	0.0	0	0.0	296
Fruitdale[a]	555	93.4	38	6.4	1	0.2	594
Highland Park[b]	194	95.1	10	4.9	0	0.0	204
Lafayette	1,952	94.8	103	5.0	5	0.2	2,060
North Pecos	80	72.1	31	27.9	0	0.0	111
North Table Mountain	1,200	98.8	10	0.8	5	0.4	1,215
North Washington Street	2,217	90.7	204	8.3	24	1.0	2,445
North West Lakewood[a]	3,972	97.7	93	2.3	0	0.0	4,065
Pleasant View[a]	980	98.0	15	1.5	5	0.5	1,000
South Adams[a]	4,466	79.7	1,140[c]	20.3	-[c]	-	5,606
Westridge	1,650	99.1	15	0.9	0	0.0	1,665
Wheatridge	8,236	86.3	1,306	13.7	0	0.0	9,542

(a) Statistical differentiation between user classes not available. These figures were approximations made by the appropriate municipal and district officials.
(b) Does not include taps in private system which connects with Highland Park.
(c) Commercial and industrial combined.
(d) Classified as having industrial wastes
NA - Not Available.

Note: Public facilities, e.g., schools, libraries are included as commercial.
In most cases the industrial class is defined by sewage discharge rather than type of business establishment.

As previously noted, the agencies included in this study employ a variety of techniques for classifying users and often do not differentiate between commercial, institutional or industrial users, but treat them as a single class.

The number and per cent distribution of the various classes of users in each classification was indicated in Table 2. Denver, with 128,870, has by far the largest number of user taps. Of those sampled, the wastewater agency with the smallest number of taps is the Berkeley Water and Sanitation District, with 51 taps. A characteristic of each of the agencies is the high proportion of residential taps and the very small proportion of users classed as commercial and, especially, industrial. Three observations can be made regarding this distribution of users: (1) in most communities, commercial and industrial land uses comprise a small proportion of the total; (2) commercial and industrial classification schemes are not well defined; and (3) with the exception of the City and County of Denver, most of the agencies serve areas predominently suburban in character with a correspondingly low number of commercial and industrial users.

To a certain extent, the deficiencies in the classification schemes (representatives of several of the districts could only estimate the proportion of non-residential users) represent preferential treatment to some users. This may or may not have been the intent of the agency. Agencies which do not differentiate between classes may knowingly or unknowingly be causing certain classes of users to subsidize others. In another vein, some communities or agencies may offer a lower rate to commercial or industrial establishments to induce them to locate in the community. While investigations undertaken in this study have not revealed evidence of this, it may be that the practice exists. Editorially speaking, a long-range effect of the EPA guidelines will be to minimize this competitive tool in seeking industrial development.

Denver Industrial Waste Program

The City and County of Denver Wastewater Control Division has been addressing this problem for over 6 years, and has been generous in sharing the results of its experience. A description of its program may be enlightening.

An extensive sampling program was initially conducted covering approximately 90 industries, and a two year average of samples was used to determine an industry "strength index." This strength index, a factor of flow and content (BOD and SS), has been in effect for four years.

Each industry is billed monthly on this constant index unless there should occur a significant change in operations which warrants adjustments of the index in reclassification of the industry. All industries for which physical provisions are available are sampled 3 or 4 times per year to insure that current discharge relates to the assigned strength index. If not, the index can be revised to reflect current loadings.

When a new industry comes on-line, it is required to make physical arrangements for sampling locations and facilities. Each new industry is assigned a "group parameter" based on the type of industry; its flow and loadings are then sampled 8-16 times to establish a base for an individual strength index.

The Denver Wastewater Control Division, based on the original extensive sampling program, has established industry classes and assigned average group parameters for BOD and SS loadings for each of these classes. These group parameters have also been assigned to industries in the same general classification which had not been individually sampled.

In 1970, there were 116 industries in Denver on which data were available, 62 of which were being sampled and 54 of which had been assigned group parameters. Table 3 breaks down the 5 existing industrial classifications and indicates the average effluent of sampled firms and the parameters for each group when they could be determined.

Similarly classified industries are not necessarily assigned the same parameters. For example, in class B, for milk processors, there are three firms which are not currently being sampled. Two of these are assigned average BOD levels of 1913 ppm (mg/litre) and SS levels of 552 ppm. A third is assigned a BOD level of 956 ppm and SS level of 552 ppm.

In class C, for industrial laundries, one has been assigned a BOD level of 996 ppm and an SS level of 954 ppm, while the other was assigned levels of 340 ppm (BOD) and 497 ppm (SS).

Other examples are evident in Group D, where industries within the same class and described as the same type are assigned different parameters. These differences may be a result of various causes: pre-treatment, dilution of wastes by use of larger quantities of water, differences in the type, method or hours of operation, or other factors established by investigation.

Another variation noted in Table 3 is that many of the group parameters differ considerably from the average values

Table 3

CITY OF DENVER INDUSTRIAL CATEGORIES
1971

Industry Class	Type of Industry	No. industries sampled	Average Effluent BOD	Average Effluent SS	No. industries assigned parameters	Effluent Parameters BOD	Effluent Parameters SS
A	Meat and meat processors	20	1042	661	18	952	623
B	Dairies and milk products						
	Butter and Cheese	0	-	-	3	1000	500
	Ice cream	0	-	-	3	600	240
	Milk	4	1650	528	3	1913(1)	552
C	Laundries	17	509	442			
	Industrial	8	457	491	2	uncertain	
	Commercial	9	556	399	6	734	571
D	Food Processors	18	1488	671			
	Bakeries	4	2376	695	8	2376	695
	Soft drink bottlers	5	679	163	2	798	138
	Food vendors	2	825	584	2	uncertain	
	Corn/potato chips	4	1303	1759	2	uncertain	
	Canneries	3	2342	93	3	uncertain	
E	Miscellaneous (serum, tanning, rendering, fabrics)	3	755	820	2	577	121
Totals		62			54		

Note - Uncertain indicates that different parameters were used for industries within the same class and described as the same type.

(1) One industry of this type assigned a different BOD value (956).

Source: City/County of Denver Wastewater Control Division

assigned to sampled industries. In only one case (bakeries) do the two values agree exactly. In others, such as commercial laundries, the assigned parameters are higher than the average sampled industries (734 vs. 566 ppm BOD and 571 vs. 399 ppm SS). In a reverse situation, Class E users are assigned parameters considerably below averages determined from sampled industries.

These comments concerning the industry classification and effluent parameters of the Denver Wastewater Control Division are cited to demonstrate the diversity of conditions identified in the Division's Industrial Waste Program, and its approach to complex and difficult problems. Initiating this program well in advance of the issuance of the E.P.A. guidelines, which now require these very types of considerations, Denver has been a leader in its efforts to assess charges to industrial users in relationship to the system loadings which they contribute.

These comments are intended to show, to some degree, the complexities of an industrial waste program, and that average effluent content even within industries of the same type can vary greatly. For example, within Class A (meat and meat processors) for sampled industries, BOD levels ranged from 362 ppm to 2,778 ppm and SS levels ranged from 191 ppm to 2,624 ppm. Even on sub-categories levels varied greatly. For milk processors, BOD levels ranged from 473 ppm to 4,206 ppm and SS levels ranged from 199 ppm to 1,187 ppm; for bakeries, BOD levels ranged from 817 ppm to 3,927 ppm and SS levels from 353 ppm to 1,343 ppm. These findings illustrate the inequities which may be inherent in user charge systems applied blindly to standard classes and sub-classes.

Difficulties of industrial classification and assignment of group effluent parameters were encountered throughout the course of this study. The Denver data and experience tend only to amplify these difficulties and to substantiate problems which must be resolved. Ideally, every industry and commercial concern which would possibly contribute system loadings in excess of "normal domestic sewage" should be sampled and evaluated on its own merits. The possible impracticalities of this solution, coupled with the difficulties of group classification, are but two of the challenges of the current EPA guidelines.

Yet, these very problems provide the substantive basis and justification for the user charge guidelines - that each user should pay its fair share.

SECTION V

SPECIFIC ANALYSES OF USER CHARGES

User Charges

Federal guidelines regarding the establishment of user charges for operation and maintenance of publicly owned treatment works state that:

> "Federal grant applicants shall be awarded grants only after the regional Administrator has determined that the applicant has adopted or will adopt a system of charges to assure that each recipient of waste treatment services will pay its proportionate share of the costs of operations and maintenance, including replacement.(8)

The guidelines also provide that:

> "The user charge system shall generate sufficient revenue to offset the cost of all treatment works operation and maintenance provided by the grantee."

As discussed in Section IV on sewer service charges, the rate schedules used by the various wastewater agencies in Denver are not consistent, nor are the schemes which are utilized for classifying users. The purpose of this section is to examine three agencies in the Denver area which have established rate schedules recognizing volume, flow and loading characteristics as rate making variables, and also currently have industrial users subject to these schedules. In this evaluation, the three primary variables of flow, BOD and SS have been considered. This may not be adequate for some wastewater agencies where dissolved solids, chemical oxygen demand, nutrients or other parameters exceed minimum acceptable levels and can be included as rate factors in the user charge schedule.

Several objectives are to be realized through this selection procedure and analysis.

1. A comparative analysis of the form, derivation, application and administration of the present user charges and the model user charges contained in the EPA guidelines.

2. Determine the degree of compliance with EPA guidelines with regard to user charges.

3. Ascertain the number, SIC classification, flows and loadings of all industrial users presently connected to the respective wastewater systems.

4. Ascertain the relative effect and desirability of applying user charges to user classes versus individual users.

Preceding page blank

5. Based on the foregoing, determine the legal, administrative, financial and physical provisions necessary to achieve conformance with the EPA guidelines with respect to user charges.

Of the 29 agencies sampled, only three other than Denver were found to charge existing industrial users on the basis of volume, flow and loading. These are: North Washington Street Water and Sanitation District, North Table Mountain Water and Sanitation District, and Crestview Sanitation District. However, Crestview has only one industry currently and, since the City of Arvada is currently in the process of surveying and classifying industrial users with the intent of instituting user charges, it was decided that North Washington, North Table Mountain and Arvada would provide quite distinctive and different approaches to procedures and situations. Therefore, the methods, application and rates charged by these three agencies were analyzed in some detail related to the requirements of the EPA user charge guidelines.

Effluent Parameters

The term "normal domestic sewage" is vague and no specific guidelines are established for appropriate or representative levels of flow, BOD or SS which are "normal" for each residential tap. In fact, these levels vary from area to area and district to district. Therefore, what is "normal" for one instance may not be "normal" in another.

Table 4 was used to attempt to establish some average level of flow for domestic sewage in the Denver area. Only agencies included in this study and those with a high proportion of residential taps were considered. Annual flows per tap varied considerably between a low of 93,000 gallons annually to 274,000 gallons. Average annual flow for the 9 agencies was 137,000 gallons. For study purposes, a minimal annual domestic flow of 120,000 gallons annually or 10,000 gallons per month was chosen. This corresponds to the annual tap flows in the Applewood Sanitation District which is completely residential.

Residential content in terms of biochemical oxygen demand (BOD) and suspended solids (SS) seems to be another unknown or variable quantity as it depends to a large degree on the types and extent of use of home appliances such as washing machines and garbage disposals. To determine the proportionate contributions to systems requirements by other users, it is necessary to estimate user loadings.

For 9 selected districts, the tons of BOD and SS were converted to parts per million. Only study districts and predominantly residential districts were chosen. Several observations result from the data shown in Table 5. National average values for BOD and SS levels usually range between 250

Table 4

EFFLUENT FLOW PER TAP
Selected Sanitation Districts
1972

MUNICIPALITY OF DISTRICT	ANNUAL FLOW PER TAP (Gallons)	PERCENT RESIDENTIAL
City of Arvada	116,000	97.5
City of Thornton	132,000	97.1
City of Westminster	139,000	96.4
Applewood S. D.	120,000	100.0
Crestview S. D.	93,000	95.0
North Table Mountain S. D.	173,000	98.8
North Washington Street, S. D.	274,000	90.7
Northwest Lakewood S. D.	181,000	97.7
Westridge S. D.	149,000	99.1
WEIGHTED ANNUAL AVERAGE FLOW	137,000	

SOURCE: Individual sanitation districts and MDSDD #1.

Table 5

EFFLUENT CONTENT
Selected Sanitation Districts
1972

MUNICIPALITY OR DISTRICT	TONS BOD	ppm	TONS SS	ppm	PERCENT RESIDENTIAL
City of Arvada	1,303	186	1,651	236	97.5
City of Thornton	1,901	221	2,543	296	97.1
City of Westminster	689	222	844	272	96.4
Applewood S. D.	53	133	72	180	100.0
Crestview W. & S. D.	333	185	351	195	95.0
North Table Mountain W. & S. D.	154	171	302	336	98.8
North Washington Street W. & S. D.	1,018	364	818	292	90.7
Northwest Lakewood S. D.	311	104	314	105	97.7
Westridge S. D.	150	150	197	197	99.1
Weighted Average		207		248	

SOURCE: Metropolitan Denver Sewage Disposal District #1

ppm and 300 ppm. However, BOD expressed in ppm in all but one case are lower than these average values. BOD ppm in all but one case are lower than SS ppm. The weighted averages are distinctly different from average levels usually assumed for households and are lower than those values assumed in Federal guidelines.

Even though this analysis was intended to provide only general average values, the variations and ranges are still considerable. These could be caused by many factors, including: commercial and industrial contribution of varying strengths; size, character and type of domestic water uses; ground water levels; construction and maintenance standards; each district's own treatment facilities and practices; high infiltration; storm sewers; high pure water use; and others.

Therefore, a range of BOD and SS levels was computed for each of the three agencies under detailed analysis later in this Section. Table 6 reflects an assumed BOD level of 300 ppm and an SS level of 300 ppm. Table 7 assumes levels of 230 ppm of BOD and 200 ppm of SS concentrations, respectively, the same as used by the North Washington Street District. Table 8 applies the same levels of BOD and SS (210 ppm and 250 ppm) that were derived as the weighted averages for selected agencies which were shown in Table 5.

In order to summarize these data, Table 9 was developed to show the total tons of domestic content (BOD and SS) based on the range of BOD levels from 210 ppm to 300 ppm and the range of SS levels from 200 ppm to 300 ppm. It can easily be seen that there can be quite a difference depending on the level which is established for "normal domestic sewage." For example, in North Washington District, the selection of an average domestic level of BOD at 210 ppm would understate the total domestic load on the system by 251 tons over what the total residential load would be based on an assumed level of 300 ppm. And this 251 tons differential occurs with an annaul flow of only 670 million gallons. For Arvada, with an annual flow of 1,672 million gallons, the differential would increase to 628 tons.

Therefore, assumed levels for flow, BOD content and SS content in "normal domestic sewage" should be chosen carefully, and analyzed and selected individually in each agency jurisdiction. Other factors must also be considered, such as infiltration, and the effect on the dilution of BOD and SS concentrations because of the increased flow. This consideration and its potential effects on the equitable user charge program, will be discussed in more detail in conjunction with the North Table Mountain analysis.

User Charges - North Washington Street Water and Sanitation District

North Washington Street Water and Sanitation District is located north of the City of Denver near the MDSDD #1

Table 6

CALCULATION OF BASE DOMESTIC FLOW,
BIOCHEMICAL OXYGEN DEMAND
AND SUSPENDED SOLIDS

Selected Municipalities and Sanitation Districts
1972

Given:

1. Biochemical oxygen demand (BOD) concentration per domestic user is 300 parts per million

2. Suspended solids (SS) concentration per domestic user is 300 parts per million.

FORMULA TO CONVERT PARTS PER MILLION TO TONS

Tons = Concentration in parts per million x 8.345 pounds per million gallons x total annual flow (mg) ÷ 2,000 pounds per ton.

For North Washington Street Water and Sanitation District - 1972

Annual Flow	=	670 million gallons
Annual Tonnage BOD	=	838
Annual Tonnage SS	=	838

For North Table Mountain Water and Sanitation District - 1972

Annual Flow	=	210 million gallons
Annual Tonnage BOD	=	263
Annual Tonnage SS	=	263

For the City of Arvada

Annual Flow	=	1,672 million gallons
Annual Tonnage BOD	=	2,092
Annual Tonnage SS	=	2,092

SOURCE: Flow data from Metropolitan Denver Sewage Disposal District #1. BOD and SS levels estimated by Wilbur Smith and Associates.

Table 7

CALCULATION OF BASE DOMESTIC FLOW,
BIOCHEMICAL OXYGEN DEMAND
AND SUSPENDED SOLIDS

Selected Municipalities and Sanitation Districts
1972

GIVEN:

1. Biochemical oxygen demand (BOD) concentration per domestic user is 230 parts per million (ppm)

2. Suspended solids (SS) concentration per domestic user is 200 parts per million (ppm)

FORMULA TO CONVERT PARTS PER MILLION TO TONS

Tons = concentration ppm X 8.345 pounds per million gallons
X total annual flow(mg) ÷ 2,000 pounds per ton.

For North Washington Street Water and Sanitation District - 1972

Annual flow	=	670 million gallons
Annual tonnage BOD	=	643
Annual tonnage SS	=	559

For North Table Mountain Water and Sanitation District - 1972

Annual flow	=	210 million gallons
Annual tonnage BOD	=	201
Annual tonnage SS	=	175

For the City of Arvada - 1972

Annual flow	=	1,672 million gallons
Annual tonnage BOD	=	1,604
Annual tonnage SS	=	1,394

SOURCE: Flow data from Metropolitan Denver Sewage Disposal District #1. BOD and SS levels are those used for calculating industrial charges by the North Washington Street Water and Sanitation District.

Table 8

CALCULATION OF BASE DOMESTIC FLOW,
BIOCHEMICAL OXYGEN DEMAND
AND SUSPENDED SOLIDS

Given:

1. Biochemical oxygen demand (BOD) concentration per domestic user is 210 parts per million (ppm)

2. Suspended solids (SS) concentration per domestic user is 250 parts per million (ppm)

FORMULA TO CONVERT PARTS PER MILLION TO TONS

Tons = concentration (ppm) X 8.345 pounds per million gallons
X total annual flow (mg) ÷ 2,000 pounds per ton.

for North Washington Street Water and Sanitation District - 1972

Annual flow	=	670 million gallons
Annual tonnage BOD	=	587
Annual tonnage SS	=	698

for North Table Mountain Water and Sanitation District - 1972

Annual flow	=	210 million gallons
Annual tonnage BOD	=	184
Annual tonnage SS	=	219

for the City of Arvada - 1972

Annual flow	=	1,672 million gallons
Annual tonnage BOD	=	1,464
Annual tonnage SS	=	1,743

SOURCE: Flow data from Metropolitan Denver Sewage Disposal District #1.
BOD and SS units estimated by Wilbur Smith and Associates.

Table 9

COMPARISON OF TONS OF DOMESTIC CONTENT LEVEL

Study Municipalities and Sanitation Districts
1972

MUNICIPALITY OR DISTRICT	CONTENT (Parts Per Million) BOD 300	BOD 230	BOD 210	SS 300	SS 200	SS 250
North Washington Street Water and Sanitation District	838	643	587	838	643	698
North Table Mountain Water and Sanitation District	263	201	184	263	175	219
City of Arvada	2092	1604	1464	2092	1394	1743

SOURCE: Base data from Metropolitan Denver Sewage Disposal District. Calculated by Wilbur Smith and Associates.

treatment plant. As a combined water and sanitation district, NWSW&SD in 1972 handled the distribution of 700 mg. of water and the collection and partial treatment of 670 mg. of sewage containing 1,357 tons of BOD and 1,091 tons of SS. Sewerage system users totalled 2445, with 2217 classed as residential, 204 classed as commercial, and 24 classed as industrial.

The district owns, operates and maintains a primary wastewater treatment facility which handles approximately one-half of the average daily flow and has a capacity of one million gallons per day. Primary treatment in this facility removes about 50 percent of the BOD and SS content of the plant influent. The remaining untreated sewage plus the effluent from the primary treatment plant are sent directly to the MDSDD #1 treatment facility.

Because North Washington Street is a combined water and sanitation district, its accounts and operating statements are often combined. In order to separate wastewater system costs from those of the water system, the district administration was asked to allocate the various annual cost items for the year 1972 attributable to the wastewater system. These costs were then further allocated according to functions such as administration, operations and maintanance, treatment and disposal, and annual fixed capital costs. Identification by function allowed a further allocation of costs either directly to users or indirectly dependent on flow, BOD or SS loading.

As shown in Table 10, total costs allocated to the wastewater system were $193,940 in 1972. Treatment and disposal was the major expense item, accounting for 76.6 percent of the total. The largest single expense was the sewer service fees charged by MDSDD #1, which amounted to $131,422 or 67.8 percent of the total. By function, the largest element was treatment and disposal while the lowest functional expense was operations and maintenance at $10,759 in 1972. Using these data as a base, it was possible to develop unit costs.

Tables 11 and 12 present the unit costs for the following categories: administrative expense per user, costs per 1000 gallons of flow, cost per ton of BOD and cost per ton of SS. Based on municipal utility operating experience and generally accepted accounting practices, the administrative expense was allocated to each user on the assumption that administrative costs per user were roughly equal. Operations and maintanance cost was assigned totally to flow, indicating that these expenses are responsive to system utilization. Treatment and disposal expense and fixed capital requirements were allocated according to flow, BOD and SS. In this respect, Tables 11 and 12 differ.

Table 10

SEWAGE COSTS BY FUNCTION
NORTH WASHINGTON STREET WATER AND SANITATION DISTRICT
Year Ended November 30, 1972

COST CATEGORY	FUNCTION				
	Administration	Operations and Maintenance	Treatment and Disposal	Fixed Capital	Total
Repairs and Maintenance		$ 4,962			$ 4,962
Sewer Service Fees			$131,422		131,422
Utilities and Power	$ 250		4,233		4,483
Salaries and Administration	3,871	4,000	8,544		16,415
Accounting and Auditing Fees	2,550				2,550
Burglar and Fire Protection	614				614
Directors Fees	1,000				1,000
Employees Hositalization Insurance	190	197	420		807
Engineering Expense	1,162				1,162
Insurance	264		1,000		1,264
Legal-Attorney's Fees	1,464				1,464
Legal-Advertising, Recording and Printing	857				857
Employees Retirement Fund	116	120	256		492
Miscellaneous Expense		848			848
Office Supplies and Expense	202				202
Postage	173				173
Supplies-Plant			185		185
Payroll Taxes	197	204	435		836
Telephone and Telemetering	140				140
Tests and Analysis			2,041		2,041
Truck Expense		428			428
Fixed Capital				$21,595	21,595
	$13,050	$10,759	$148,536	$21,595	$193,940

SOURCE: Financial Statements and Accountant's Report, North Washington Street Water and Sanitation District, Adams County, November 30, 1972.
Percent allocations provided by North Washington Street personnel

Table 11

CALCULATION OF TOTAL AND UNIT USER CHARGES
BY FUNCTION
(based on MDSDD #1 Allocation formula)
NORTH WASHINGTON STREET WATER AND SANITATION DISTRICT
1972

1.	ADMINISTRATIVE EXPENSES (Spread evenly among users)		
	Administration expense	=	$13,050
	Total number of users	=	2,445
2.	OPERATIONS AND MAINTENANCE EXPENSE (Per unit flow)		
	Total operations and maintenance expense	=	10,759
	Total annual flow (Millions of gallons, 1972)	=	670
3.	TREATMENT and DISPOSAL EXPENSE (Flow, BOD, SS)		
	Total treatment and disposal expense	=	148,540
	Allocation of expense:		
	Flow = 45.5%	=	67,580
	Biochemical oxygen demand = 30.9%	=	45,900
	Suspended solids = 23.6%	=	35,060
	(SOURCE: MDSDD #1)		
4.	FIXED CAPITAL (Flow, BOD, SS)		
	Total annual fixed capital expense		$21,600
	Allocation of expense:		
	Flow = 45.5%	=	9,830
	Biochemical oxygen demand = 30.9%	=	6,670
	Suspended solids = 23.6%	=	5,100
	(SOURCE: MDSDD #1)		
5.	TOTAL UNIT COSTS PER USER AND PER UNIT FLOW, BOD AND SS		
	Administration Unit Costs (per user)		
	Administration		5.34
	Flow unit costs (per 1,000 gallons)		
	Administration		0.000
	Operations and Maintenance		0.016
	Treatment and Disposal		0.101
	Fixed Capital		0.015
	Total per 1,000 gallons		$0.132
	Biochemical oxygen demand (BOD) unit costs (per ton)		
	Administration		0.000
	Operations and Maintenance		0.000
	Treatment and Disposal		33.825
	Fixed Capital		4.915
	Total per ton		$38.740
	Suspended solids (SS) unit costs, (per ton)		
	Administration		0.000
	Operations and Maintenance		0.000
	Treatment and Disposal		32.136
	Fixed Capital		4.675
	Total per ton		$36.811

SOURCE: Cost data estimated by Wilbur Smith and Associates from Financial Statements and Accountants Report, North Washington Street Water and Sanitation District, Adams County, November 30, 1972.

Table 12

CALCULATION OF TOTAL AND UNIT USER CHARGES
BY FUNCTION
(Based on WSA Allocation Formula)
NORTH WASHINGTON STREET WATER AND SANITATION DISTRICT
1972

1.	ADMINISTRATIVE EXPENSES (Spread evenly among users)		
	Administration expense	=	$ 13,050
	Total number of users	=	2,445
2.	OPERATIONS AND MAINTENANCE EXPENSE (Per unit of flow)		
	Total operations and maintenance expense	=	$ 10,759
	Total annual flow (millions of gallons)		670
3.	TREATMENT AND DISPOSAL EXPENSE (flow, BOD, SS)		
	Total treatment and disposal expense	=	$148,540
	Allocation of expense:		
	Flow = 30%	=	$ 44,560
	Biochemical oxygen demand = 40%		59,420
	Suspended solids = 30%		44,560
	(SOURCE: WS&A)		
4.	FIXED CAPITAL (flow, BOD, SS)		
	Total fixed capital expense	=	$ 21,600
	Allocation of expense:		
	Flow = 45.5%		$ 9,830
	Biochemical oxygen demand = 30.9%		6,620
	Suspended solids = 23.6%	=	5,100
	(SOURCE: MDSDD #1)		
5.	TOTAL UNIT COST PER USER AND PER UNIT FLOW, BOD AND SS		
	Administration unit cost (per user)		
	Administration		5.34
	Flow Unit costs (per 1,000 gallons)		
	Administration		$ 0.000
	Operations and Maintenance		0.016
	Treatment and Disposal		0.067
	Fixed Capital		0.010
	Total per 1,000 gallons		$ 0.093
	Biochemical Oxygen demand (BOD) unit costs (per ton)		
	Administration		0.000
	Operations and Maintenance		0.000
	Treatment and Disposal		43.788
	Fixed Capital		4.915
	Total per ton		$ 48.703
	Suspended solids (SS) unit costs (per ton)		
	Administration		$ 0.000
	Operations and Maintenance		0.000
	Treatment and Disposal		40.843
	Fixed Capital		4.675
	Total per ton		$ 45.518

SOURCE: Cost data estimated by Wilbur Smith and Associates from Financial Statements and Accountants' Report, North Washington Street Water and Sanitation District, Adams County November 30, 1972.

Table 11 assumes the same allocation percentages used by MDSDD #1, a regional treatment and disposal agency, while Table 12 assumes a distribution which, although arbitrary, has been found by various studies of local agencies to represent typical cost distribution.(4) Accordingly, Tables 11 and 12 differ in that a higher percentage of costs are allocated to BOD and SS than to flow in Table 12.

Although North Washington Street Water and Sanitation District has 24 "industries," a variety of methods are employed to determine user charges. Some industrial users are charged on the basis of the number of facilities such as water taps, washroom facilities and drains. Some industrial users pay on the basis of volume of water use while others pay on the basis of negotiated contract. Four industries are charged on the basis of the type, quantity and content of discharge. Because industrial waste characteristics can vary so greatly between industries, these 4 industries for which detailed flow, BOD and SS records were available were used in the analysis of user charges for industry. The industries and their SIC classification are given below:

Industry Name	Product	SIC Classification
Wilhelm Foods	Food Processing	2033
Continental Baking	Bakery	2051
National By-Products	Meat by-products	2077
Chapparell Industries	Snowmobiles	3799

Tables 13 and 14 show the charges which these industries would pay according to the functional cost breakdown under the two cost distributions and the charges actually levied by NWSW&SD. Table 13 uses the MDSDD #1 allocation. The results indicate that the industries are possibly being undercharged a total of $1,730 or 3.0 percent. Table 14, using the cost allocations which place a higher burden on content than flow, indicate that these industries may have underpaid in 1972 by a total of $5,744 or 10.1 percent.

Charges to these industries are calculated by NWSW&SD according to a formula. The calculation card used by NWSW&SD is shown in Figure 2. Since this formula apparently underestimates the actual costs, an analysis of the formula was conducted to determine what changes might be made to bring it more in line with actual costs.

A feature of the industrial charge formula is that each 1000 gallons of flow with a maximum content of 230 ppm of BOD and 200 ppm of SS is charged at a rate of $.18. Each ppm of BOD in excess of 230 ppm is charged $.00018 and each ppm of SS in excess of 200 ppm is charged at $.00016. Table 15 shows the derivation of the initial flow charge under the two cost allocation assumptions. Interestingly, the calculated charge using the MDSDD #1 cost allocation should be $.200 while under the Table 14

Table 13

CALCULATED AND ACTUAL CHARGES FOR MEASURED INDUSTRIES
USING MDSDD#1 ALLOCATION

North Washington Street Water and Sanitation District
1972

TYPE OF CHARGE	QUANTITY	RATE	AMOUNT
Administration	4	$ 5.34	$ 21
Flow (mg.)	157.19	132.00	20,749
Biochemical Oxygen Demand (Tons)	493.06	38.74	19,101
Suspended Solids (Tons)	510.56	36.81	18,794
Total Calculated Charge			$58,665
Actual Charge by NWSW&SD			$56,935
Deficit			$ 1,730

SOURCE: Flow and content data from North Washington Street Water and Sanitation District. Applicable rate calculated by Wilbur Smith and Assoicates based on percentage charge allocation used by MDSDD#1 as follows: Flow = 45.5 percent, BOD = 30.9 percent and SS = 23.6 percent of treatment and disposal and fixed capital expense.

Table 14

CALCULATED AND ACTUAL CHARGES FOR
MEASURED INDUSTRIES USING WS&A ALLOCATION

North Washington Street Water and Sanitation District
1972

Type of Charge	Quantity	Rate	Amount
Administration	4	$5.34	$21
Flow (mg)	157.19	98.00	15,405
Biochemical Oxygen Demand (Tons)	493.06	50.16	24,012
Suspended Solids (Tons)	510.56	47.11	23,241
Total Calculated Charge			$62,679
Actual Charge by NWSW & SD			$56,935
Deficit			$ 5,744

SOURCE: Flow and content data from North Washington Street Water and Sanitation District. Applicable rate calculated by Wilbur Smith and Associates based on percentage charge allocation estimated by WS&A as follows: Flow = 30 percent, BOD = 40 percent and SS= 30 percent of treatment and disposal and the MDSDD #1 allocation of fixed capital expense of Flow = 45.4%, BOD = 30.9%, SS = 23.6%.

INDUSTRIAL RATE CALCULATION FOR: _____

MONTH _____ WASTE FLOW _____ GALS.

YEAR _____ AVG. BOD _____ M/L

AVG. S. S. _____ M/L

BOD FACTOR _____ -230 X .001 = _____

S. S. FACTOR _____ -200 X .0009 = _____

FLOW FACTOR 1.00

TOTAL FACTOR _____

TOTAL BILL _____ (1,000 Gallons) X $ .18 X _____ (Factor) = $ _____

NORTH WASHINGTON STREET
WATER AND SANITATION DISTRICT

INDUSTRIAL RATE CALCULATION FORMULA

Figure 2

Table 15

APPLICABLE CHARGE PER 1000 GALLONS FLOW WITH BASE EFFLUENT CONTENT

North Washington Street Water and Sanitation District 1972

GIVEN:

Flow	=	1,000 gallons
BOD*	=	230 ppm or .000959 Tons
SS	=	200 ppm or .000834 Tons

Cost per 1,000 gallons based on MDSDD#1 expense allocation:

Flow	=	$0.132
BOD	=	0.037
SS	=	0.031
Total	=	$0.200 per 1,000 gallons

Cost per 1,000 gallons based on WS&A and MDSDD #1 Expense Allocation

Flow	=	$0.098
BOD	=	0.047
SS	=	0.038
Total	=	$0.183 per 1,000 gallons

NOTES: MDSDD#1 Expense allocation as follows: Flow = 45.5 percent, BOD = 30.9 percent and SS = 23.6 percent of total treatment and disposal and fixed capital expense. WS&A expense allocation as follows: flow = 30 percent, BOD = 40 percent and SS = 30 percent.

* Factors derived:

ppm x 8.345 ÷ 2000 ÷ 1000 = tons/1000 gallons

allocation the charges should be $.183, the amount currently charged. Using the Table 14 cost allocations, it can be calculated that the cost of operations and maintenance with regard to 1 ppm of BOD per 1000 gallons of flow is $.000204 and 1 ppm of SS is $.000190. Accordingly, the rate charged per part per million of BOD in excess of 230 ppm should be adjusted upward by 113 percent and the rate for SS in excess of 200 ppm should be adjusted by 119 percent. With these changes, the current formula would have recovered total applicable costs in 1972.

Since actual costs can only be determined at the end of the year, the formula must be adjusted either on the basis of budgeted costs or on the basis of the previous year's costs. Neither of these methods assures recovery in any given year. Thus, attention could be given to means of guaranteed recovery such as some method of backcharge.

A further stipulation of the Federal Guidelines was that each agency "... will adopt a system of charges to assure that each recipient of waste treatment services will pay its proportionate share of the costs..." In the previous section, only 4 of the industries in the NWSW&SD have been considered. This was because measurement of flow, volume and loading had been conducted for these allowing a direct comparison of actual cost and revenue. Unfortunately, this is not true of the residential, commercial and the other industrial users. Nevertheless, an analysis in general terms of these users can be made.

Accordingly, a residential or base domestic loading for North Washington Street Water and Sanitation District of 230 ppm of BOD and 200 ppm of SS was chosen. This level is consistent with the base levels assumed in the industrial formula and seems to be about average when compared with base level content assumed in other areas.(5)

Table 16 shows the flow and BOD and SS loading for the three distinguishable classes of users in the NWSW&SD. From these data it is possible to estimate the user cost responsibility of each group and then to compare that cost responsibility with the actual fees charged by the district.

Total annual charges or cost responsibility of each type of user are shown in Table 17 and are based on the cost allocation distribution developed by Wilbur Smith and Associates. In total, wastewater system users were undercharged by 61.2 percent; however, the variation among users was significant. Residential users who are charged $1.00 per month were undercharged by 114.4 percent. This indicates that residential users should be paying on a flat rate about $2.30 per month or $27.60 annually. Those

Table 16

ESTIMATED FLOW AND LOADINGS BY ALL USERS

North Washington Street Water and Sanitation District

1972

TYPE OF USER	CONTENT		
	Flow (mg)	BOD (tons)	SS (tons)
Residential	266	255	221
Measured Industrial	157	493	511
Others (non-measured industrial and commercial)	247	609	359
TOTAL	670	1357	1091

SOURCE: Residential based on 2217 users, BOD of 230 ppm and SS of 200 ppm and flow of 120,000 gpy. Measured industrial see Table 14. Others are the remaining amounts.

Table 17

ESTIMATED AND ACTUAL CHARGES BY ALL USERS

North Washington Street Water and Sanitation District
1972

TYPE OF USER	ESTIMATED CHARGE	ACTUAL CHARGE	DIFFERENCE Number	DIFFERENCE Per Cent
Residential	$60,500	$28,222	$32,278	114.4
Measured Industrial	62,679	56,935	5,744	10.1
Others (non-measured industrial and commercial	70,761	35,148	35,613	101.3
TOTAL	$193,940	$120,305	$73,635	61.2

SOURCE: Residential estimated charge based on Flow = 266 mg at a processing cost of $.183 per 1000 gallons and a per user administrative charge of $5.33 per year.
Measured industrial from Table 14.
Others estimated charge based on revised industrial cost recovery formula

industrial users whose flow, volume and loading are measured are most nearly carrying their share with an 10.1 percent underpayment. Necessary adjustments to the charge formula have already been discussed. Remaining users, which include non-measured industrial users and commercial users, are paying about one-half their share with 101.3 percent underpayment. User charges can be estimated for these users based on estimated and assumed levels of flow and content applicable to the user class category.

Finally, with regard to user charges in the North Washington Street Water and Sanitation District, two important observations can be made in addition to those already cited. Because NWSW&SD is a combined water and sanitation district, the various accounts are not separated but are combined thus not allowing an accurate cost accounting of actual expenses attributable to the two functions. Although the district did operate at a net loss ($10,708 before depreciation in 1972) it is apparent that water users through their fee structure are, in effect, subsidizing the wastewater system operations. Therefore, it could be concluded that the North Washington Street Water and Sanitation District is not currently in compliance with the Federal Guidelines with regard to user charges although it could be considered in substantive compliance in terms of those industries for which flow, volume and loading information are available.

User Charges - North Table Mountain Water and Sanitation District

The North Table Mountain Water and Sanitation District is located west of the city of Denver, near Golden. The North Table Mountain District (NTMD) provides no treatment facilities for sewage originating within the district, all wastewater collected being transmitted direct to the Metropolitan Denver Sewage Disposal District #1 (MDSDD #1) facilities. In 1972, the NTMD had an average total of 480 users, 467[6] of which were residential, 10 were classed commercial and 3 were classed as industrial.

In 1972, the district, according to MDSDD #1 statistics, NTMD transmitted 210 million gallons of sewage, which contained 154 tons of biochemical oxygen demand (BOD) and 302 tons of suspended solids (SS).

As a combined water and sanitation district, financial accounts and operating statements are commingled. Because of the difficulty of identifying and separating wastewater system costs from those of the water system, the NTMD administration was requested to allocate the various operating expense items for the year 1972 to the wastewater system. These costs were then further allocated according to functions, such as administration, operations and maintenance, treatment and disposal, and annual fixed capital costs. This identification by function permitted an allocation of cost

either directly to users or indirectly, dependent on flow, BOD or SS loading.

As shown in Table 18, the total costs allocated to the operations of the wastewater system were $49,550 in 1972. During that period, there were no fixed capital expenditures to be financed through user charges. The largest category of expense was treatment and disposal, representing $35,861 or 72.4%. The largest single item within this category was the service fees charged by MDSDD #1, totalling $34,744. Operations and maintenance and administrative expenses were relatively small portions of the total, accounting for only 10.5% and 17.1% respectively.

Utilizing this particular expense breakdown, it was then possible to develop unit costs. Tables 19 and 20 present the unit costs of the following categories: administrative expenses per user, costs per thousand gallons of flow, cost per ton of BOD and cost per ton of SS. Based on municipal utility operating experience and generally accepted accounting practices, the administrative expense was spread among all users on the assumption that administrative costs per user were roughly equal. This resulted in an administrative cost per user of $17.68 per year. Operations and maintenance cost was assigned totally to flow, indicating that these expenses are responsive to system utilization. Based on an operations and maintenance expense of $5,203 and a total annual flow of 210 million gallons, it was determined that the O & M expense per 1000 gallons was about $.025.

Treatment and disposal expense and fixed capital requirements were allocated according to flow, BOD and SS. It is in this regard that Table 19 and 20 differ. Table 19 assumes the same allocation percentages used by MDSDD #1 for both categories, while Table 20 assumes a distribution of treatment and disposal expenses which although arbitrary, has been found to represent typical cost distribution.(7) In Table 20, however, the MDSDD #1 allocation of expenses for fixed capital was retained. Primarily, these two tables differ in that a higher percentage of costs are allocated to BOD and SS in Table 20, as opposed to the somewhat higher cost allocation to flow which is reflected in Table 19.

From the data which were analyzed, and from discussions with North Table Mountain District personnel, it was obvious that one problem which would present difficulties in the computation of equitable user ratios for all system users was the high incidence of infiltration evident in this district. Estimates of the volume of infiltration ranged from 40% to as high as 60% of the total flow. In fact, in the final adjustments by MDSDD #1 of 1972 loadings and annual charges, the measured flow of 210 gallons from NTMD was many

Table 18

SEWAGE COSTS BY FUNCTION
North Table Mountain Water and Sanitation District
Year Ended November 30, 1972

	FUNCTION				
Cost Category	Administrative	Operations and Maintenance	Treatment and Disposal	Fixed Capital	Total
Salaries	$1,999				$1,999
Engineering-Sewer	2,029	$2,028			4,057
Sewer Maintenance		2,186			2,186
Sewer Charges Metro Denver			$34,744		34,744
Power - Water			134		134
Telemetering Service			77		77
Automotive Costs		218			218
Tools		771			771
Analysis, Sewage - industries			906		906
Audit Fee	180				180
Directors Fees	1,650				1,650
Election Expense	262				262
County Treasurers Fee	543				543
Legal Fees	770				770
Insurance and Bonds	153				153
Dues	56				56
Printing & Misc.	237				237
Office rent	212				212
Office Supplies	196				196
Payroll Taxes	104				104
Telephone	95				95
Bond Principal and Interest					
Capital Expenditures					
	$8,486	$5,203	$35,861	-0-	$49,550

Source: Financial Statement and Accountant's Report, North Table Mountain Water and Sanitation District, Jefferson County, November 30, 1972 (Kennedy and Lesan, CPA)
Percent allocations to sewer operation provided by North Table Mountain personnel.

Table 19

TOTAL AND UNIT USER CHARGES
BY FUNCTION
(Based on MDSDD #1 Allocation Formula)
North Table Mountain Water and Sanitation District
1972

1.	ADMINISTRATIVE EXPENSES (spread evenly among users)	
	Administration expense =	$8,486
	Total number of users	48.0
2.	OPERATIONS AND MAINTENANCE EXPENSE (per unit flow)	
	Total operations and maintenance expense	$5,203
	Total annual flow (million of gallons, 1972)	210
3.	TREATMENT AND DISPOSAL EXPENSE (Flow, BOD and SS)	
	Total treatment and disposal expense	$35,861
	Allocation of Expense:	
	Flow = 45.5%	
	Biochemical oxygen demand = 30.9%	
	Suspended solids = 23.6%	
4.	FIXED CAPITAL (Flow, BOD and SS)	-0-
	Total annual fixed capital expense	
	Allocation of expense:	
	Flow = 45.5%	--
	Biochemical oxygen demand = 30.9%	--
	Suspended solids = 23.6%	--
	(SOURCE: MDSDD #1)	
5.	TOTAL UNIT COSTS PER USER AND PER UNIT FLOW, BOD AND SS	
	Administration Unit costs (per user)	$17.68
	Flow unit costs (per 1000 gallons)	
	Administration	$ 0.000
	Operations and Maintenance	0.025
	Treatment and Disposal	0.078
	Fixed Capital	0.000
	TOTAL per 1000 gallons	$ 0.103
	Biochemical oxygen demand (BOD) unit costs (per ton)	
	Administration	$ 0.000
	Operations and Maintenance	0.000
	Treatment and Disposal	71.955
	Fixed Capital	0.000
	TOTAL per ton	$71.955
	Suspended Solids (SS) unit costs (per ton)	
	Administration	$ 0.000
	Operations and Maintenance	0.000
	Treatment and Disposal	28.023
	Fixed Capital	0.000
	TOTAL per ton	$28.023

Source: Cost data estimated by Wilbur Smith and Associates from Financial Statement and Accountant's Report, North Table Mountain Water and Sanitation District, Jefferson County, November 30, 1972 (Kennedy and Lesan, CPA)

Table 20

TOTAL AND UNIT USER CHARGES
BY FUNCTION
(Based on WS&A Allocation Formula)
North Table Mountain Water and Sanitation District
1972

1.	ADMINISTRATIVE EXPENSES (spread evenly among users)		
	Administration expense		$8,486
	Total number of users		480
2.	OPERATIONS AND MAINTENANCE EXPENSE (per unit flow)		
	Total operations and maintenance expense		$5,203
	Total annual flow (millions of gallons, 1972)		210
3.	TREATMENT AND DISPOSAL EXPENSE (Flow, BOD and SS)		
	Total treatment and disposal expense		$35,861
	Allocation of Expense:		
	Flow	= 30.0%	10,758
	Biochemical oxygen demand	= 40.0%	14,345
	Suspended Solids	= 30.0%	10,758
	(SOURCE: WS&A)		
4.	FIXED CAPITAL (Flow, BOD, and SS)		
	Total annual fixed capital expense		-0-
	Allocation of expense:		
	Flow	= 45.5%	--
	Biochemical oxygen demand	= 30.9%	--
	Suspended Solids	= 23.6%	--
	(SOURCE: MDSDD #1)		
5.	TOTAL UNIT COSTS PER USER AND PER UNIT FLOW, BOD AND SS		
	Administration Unit Costs (per user)		$17.68
	Flow Unit Costs (per 1000 gallons)		
	Administration		$ 0.000
	Operations and Maintenance		0.025
	Treatment and Disposal		0.051
	Fixed Capital		0.000
	TOTAL per 1000 gallons		$ 0.076
	Biochemical Oxygen Demand (BOD) unit cost (per ton)		
	Administration		$ 0.000
	Operations and Maintenance		0.000
	Treatment and Disposal		93.149
	Fixed Capital		0.000
	TOTAL per ton		$93.149
	Suspended Solids (SS) unit costs (per ton)		
	Administration		$ 0.000
	Operations and Maintenance		0.000
	Treatment and Disposal		35.623
	Fixed Capital		0.000
	TOTAL per ton		$35.623

Source: Cost data estimated by Wilbur Smith and Associates from Financial Statement and Accountant's Report, North Table Mountain Water and Sanitation District, Jefferson County November 30, 1972 (Kennedy and Lesan, CPA)

times greater than the originally estimated 54 million gallons. These differences in calculation and estimates of flow from that which was recorded by MDSDD #1 are probably a function of several factors, but it is obvious that infiltration is a major factor.

The high degree of infiltration further complicates the analysis of system loadings since, in effect, it may dilute or increase the BOD and SS levels which are measured. Therefore, it is probable that the total actual tons of BOD and SS attributable to users were different than those reported by MDSDD #1, and calculating the proportionate loadings of all residential users and measured industries within the district is thus subject to error.

Table 21 reflects the estimated flow and loadings for three classes of users based on the average parameters. It can be seen that the estimated flow which is unaccounted for (infiltration, etc.) represents 127 million gallons. Since it is impossible to pinpoint this quantity and its source and because the exact effect on the BOD and SS levels cannot be determined, it becomes necessary to allocate the MDSDD #1 measured volumes to these user classes.

Table 22 shows the percentage share of each user class to the estimated volumes derived in Table 21. Residential users, based on average parameters, would account for 67.5% of the flow, 53.7% of the BOD content and 16.5% of the SS content. Industrial users (their volumes based on actual samples) would account for 30.1% of the flow, 44.4% of the BOD content, and 82.9% of the SS content. Commercial users account for the balance.

Taking these percentage shares of total system demand for each user class, it was possible to apportion the MDSDD #1 measured quantities. Table 23 reflects these allocations. Flow and BOD levels are increased in every case while SS levels are decreased to arrive back at the control totals. These are the flows and loadings for each class which were used in allocating costs and determining the order of magnitude of equitable user charges.

During 1972, three industries within North Table Mountain District were measured periodically to determine their respective load upon the system. Detailed records of the flow, BOD and SS were maintained and were available to be used in this analysis of user charges for industries. The industries involved and their SIC classification are given below.

Industry	Product	SIC Classification
Jeffco Manufacturing	Steel and Aluminum cans	3411
Boise-Cascade	Corrugated containers	2651
Hazen Research	Chemicals	2819

Table 21

ESTIMATED FLOW AND LOADINGS BY ALL USERS

North Table Mountain Water and Sanitation District
1972

TYPE OF USER	NUMBER	FLOW mg	BOD Tons	SS Tons
Residential	467	56	58	58
Commercial and Light Industrial	10	2	2	2
Measured Industrial	3	25	48	291
Sub Total	480	83	108	351
TOTAL (MDSDD #1)	-	210	154	302
unaccounted for (infiltration, etc.)		127	46	(49)

Note: Residential based on 120,000 gallons per year with contents of 250 ppm BOD and 250 ppm SS. Commercial based on 240,000 gallons per year with content of 250 ppm BOD and 250 ppm SS. Industrial based on measured samples. The number of residential sewer taps is 1972 average; 177 in January increasing to 737 in December.

The "unaccounted for" quantities will obviously vary depending on the Flow, BOD and SS assumptions per user.

Table 22

USER SHARE OF SYSTEM LOAD
BASED ON ESTIMATED LOADINGS (Table 21)

North Table Mountain Water and Sanitation District
1972

	Flow mg	%	BOD Tons	%	SS Tons	%
Residential	56	67.5	58	53.7	58	16.5
Commercial and Light Industrial	2	2.4	2	1.9	2	.6
Measured Industrial	25	30.1	48	44.4	291	82.9
TOTAL	83		108		351	

Table 23

ADJUSTED FLOW AND LOADINGS
BASED ON ESTIMATED SHARE ALLOCATION (Table 22)

North Table Mountain Water and Sanitation District

	Flow mg	BOD Tons	SS Tons
Residential	142	83	50
Commercial and Light Industrial	5	3	2
Measured Industrial	63	68	250
MDSDD #1 TOTALS	210	154	302

SOURCE: Total from Metropolitan Denver Sewage Disposal District No. 1.

Allocations to user class by Wilbur Smith and Associates

Tables 24 and 25 show the estimated charges which these industries would pay according to a functional cost breakdown under the two cost distributions, described in Tables 19 and 20, as compared with the actual charges levied by North Table Mountain District. Table 24 uses the MDSDD #1 allocation. The results indicate that the industries may have been overcharged by a total of $7,820.67. Table 25 uses the cost allocation assumed by Wilbur Smith and Associates for treatment and disposal and the MDSDD #1 allocation for fixed capital. Under this allocation, which places a higher burden on content than on flow, the indication is that the industries may have been overcharged by a total of $6,180.75 in 1972.

The North Table Mountain District does not have an established formula by which it charges industrial users based on the loadings upon the system. Generally speaking, the district charges each industry on a monthly rate, based on 75% of the water usage. Then, at the end of each year, when the precise total system loadings are determined by MDSDD #1, a computation is made of the various contributors, (residential, commercial and industrial) to the system, and industries are back-charged an appropriate amount to cover the costs of their respective loading upon the system. In 1972, these three industries were charged a total of $10,736.90, billed monthly, as a result of their water usage. At the end of the year, through a formula calculation to cover the total charges by MDSDD #1, it was determined that these three industries should pay an additional $15,244.99 as a back charge. This resulted in total charges of $26,260.99 as shown as the actual charge by the North Table Mountain District for these industries. It would appear from these calculations that the primary concern of the back-charge calculation was recovering the cost charged by MDSDD #1 with a 33% - 36% override to cover administration, operations and maintenance of the system. It appears that industrial users are being required to pay for all unaccounted for loads to the system (infiltration, etc.) rather than apportioning these to all users.

In order to equitably distribute these effects to all users, it was necessary to take the adjusted flow and loadings for each class (from Table 23) and determine the average annual flow per user and the applicable ppm ratio for BOD and SS. Table 26 reflects the revised flow allocation, raising the residential users from 120,000 gallons/year to 304,000 gallons/year. Table 27 shows the new BOD and SS levels based on this flow for both residential and commercial users. These relationships are down from the original parameter of 250 ppm for each.

Based on these assigned allocations, it was then possible

Table 24

CALCULATED AND ACTUAL CHARGES FOR
MEASURED INDUSTRIES USING MDSDD #1 ALLOCATION

North Table Mountain Water and Sanitation District
1972

TYPE OF CHARGE	QUANTITY	RATE	AMOUNT
Administration	3	$17.68	$53.04
Flow (mg)(1)	63	$103.00	6489.00
Biochemical Oxygen Demand (Tons)	68	71.96	4893.28
Suspended Solids (Tons)	250	28.02	7005.00
TOTAL CALCULATED CHARGE			$18,440.32
ACTUAL CHARGE BY NTMW&SD			$26,260.99
Excess			$ 7,820.67

(1) Based on 75% of water usage.

Table 25

CALCULATED AND ACTUAL CHARGES FOR
MEASURED INDUSTRIES USING REVISED (WSA) ALLOCATION

North Table Mountain Water and Sanitation District
1972

TYPE OF CHARGE	REVISED QUANTITY	RATE	AMOUNT
Administration	3	$17.68	$53.04
Flow (mg)	63	76.00	4788.00
BOD (Tons)	68	93.15	6334.20
SS (Tons)	250	35.62	8905.00
TOTAL CALCULATED CHARGE			$20,080.24
ANNUAL CHARGE BY NTMW&SD			$26,260.99
EXCESS			$ 6,180.75

Table 26

ADJUSTED ANNUAL FLOW QUANTITIES BASED
ON ALLOCATED USAGE (TABLE 23)

North Table Mountain Water and Sanitation District
1972

TYPE USER	NUMBER	FLOW mg	GALLONS PER YEAR PER USER
Residential	467	142	304,000
Commercial	10	5	500,000
Industrial	3	63	21,000,000

Note: These were revised from previous estimates of 120,000 gallons/year for residential users, 240,000 gallons/year for commercial users, and from industrial usage based on 75% of their water bill as shown in Table 21. These revisions were based on the allocated quantities for each class derived from MDSDD #1 totals shown in Table 23.

Table 27

ADJUSTED BOD AND SS LEVELS
BASED ON ALLOCATED USAGE BY USER CLASS

North Table Mountain Water and Sanitation District
1972

	BOD ppm	SS ppm
Residential	140	84
Commercial	144	96
Industrial	259	951

Note: Residential and Commercial BOD and SS levels were originally estimated at 250 ppm (See Table 21). Formula:

$$\frac{\text{BOD or SS (ppm)} \times 8.345 \times \text{flow (mg)}}{2000} = \text{BOD or SS (Tons)}$$

Note: These levels should not be construed as "normal domestic sewage," but merely as adjustments applicable only to conditions in North Table Mountain Water and Sanitation District.

Allocations by Wilbur Smith and Associates

to determine the applicable charge per 1000 gallons of flow containing the revised base effluent content. The revised base effluent content is defined in this case as 140 ppm BOD and 84 ppm SS for residential users, and 144 ppm BOD and 96 ppm SS for commercial users, as shown in Table 27 (these should not be interpreted as "normal domestic sewage" levels).

In Table 28, using the expense allocation of MDSDD #1, expenses for the processing of 1000 gallons of sewage at these levels are shown as 15.5¢ for residential users and 15.7¢ for commercial users. Based on the Wilbur Smith and Associates calculated expense allocation, the cost for processing the same 1000 gallons would be 14.2¢, and 14.6¢ respectively.

Based on the estimated costs per 1000 gallons of flow for residential and commercial users derived from the alternate cost allocation formula from Table 28, for residential and commercial users, and using the user charge revenue required from industries, as shown in Table 25, it was possible to calculate the estimated charge per user class to recover appropriate expenses.

Table 29 shows a summary of these calculations. It is obvious that total revenues are extremely close to total expenses based on the current method of charging. In fact, the actual charges were closer to actual expenses by $119 than were the estimated charges.

However, the practice of charging residential customers at $4.00 per month, and allocating all additional expenses not covered by this revenue to industrial users at the end of the year, results in an inequitable distribution of cost burden.

Based on previous allocation methods, residential users should be contributing $28,283, which is $5,875 more than was charged to this class in 1972. This results in a 26.2% underpayment, while industry is shown to have been overcharged by $6,181 or 23.4%. This proportionate allocation of expense recovery would have required payment of slightly over $60 per year per residential user, or about $5.00 per month.

Finally, with regard to user charges in the North Table Mountain Water and Sanitation District, several important observations, in addition to those already cited, should be made. As with the North Washington Street District, also a combined water and sanitiation district, the various funds and accounts are not separated, but are combined. This does not permit accurate cost accounting or intelligent allocation of expenses attributable to the wastewater functions. Further, the calculation by the district of

Table 28

APPLICABLE CHARGE PER 1,000 GALLONS FLOW
BASED ON ADJUSTED EFFLUENT CONTENT
AND REVISED FLOW ALLOCATIONS

North Table Mountain Water and Sanitation District
1972

Given:

Flow = 1,000 gallons
BOD* = residential - 140 ppm or .000584 tons/1000 gallons.
= commercial - 144 ppm or .000601 tons/1000 gallons
SS = residential - 84 ppm or .000350 tons/1000 gallons
commercial - 96 ppm or .000401 tons/1000 gallons

Cost per 1000 gallons based on MD&DD #1 allocation:

	Residential	Commercial
Flow	$0.103	$0.103
BOD	0.042	0.043
SS	0.010	0.011
TOTAL	$0.155	$0.157

Cost per 1000 gallons based on Wilbur Smith and Associates allocation:

	Residential	Commercial
Flow	$0.076	$0.076
BOD	0.054	0.056
SS	0.012	0.014
TOTAL	$0.142	$0.146

* Factors derived: ppm x 8.345 ÷ 2000 ÷ 1000 = tons/1000 gallons.

Note: BOD and SS levels should not be interpreted as levels for "normal domestic sewage." These factors evolved from considerations of special circumstances in the NTMWSD and are used only to apportion total costs to relative usage.

Table 29

ESTIMATED AND ACTUAL CHARGES BY ALL USERS

North Table Mountain Water and Sanitation District
1972

TYPE USER	NUMBER	ESTIMATED CHARGE	ACTUAL CHARGE	DIFFERENCE	PERCENT
Residential	467	$28,283	$22,408	- $5,875	-26.2%
Commercial and Light Industrial	10	$ 907	$ 720*	- $ 187	-26.0%
Measured Industrial	3	$20,080	$26,261	+ $6,181	+23.4%
TOTAL		$49,270	$49,389	+$ 119	+ .2%
ACTUAL EXPENSES		$49,550	$49,550		
DEFICIT		$ 280	$ 161		

Note: Residential based on a per user charge of $17.68 plus a cost of $0.142 per 1000 gallons and an allocated usage of 304,000 gallons per year.

Industrial from Table 25.

Commercial based on a per user charge of $17.68 plus a cost of $0.146 per 1000 gallons and an allocated usage cost of 500,000 gallons per year.

* Estimated; based on 75% of water bill.

user charges for the various classes of users is not designed for total cost recovery, but for recovery of only that amount charged by MDSDD #1 plus a 33% factor for administration and operation. The aggregate user charges levied in 1972, including the back charges at the end of the year to measured industrial users, appear to be adequate on the surface to cover overall general administrative, operations and maintenance, and treatment and disposal expenses as defined by the district.

It could be concluded that the North Table Mountain Water and Sanitation District is not currently in total compliance with the Federal guidelines with regard to user charges. It is obvious, however, that this district is consciously attempting to levy user charges based on loadings to the system, and is at least in compliance with the intent of EPA guidelines to apportion cost directly to users based on their respective load on the system. The discrepancy apparently lies principally within the accounting procedures and the allocation of charges attributable to unaccounted-for flow (e.g., infiltration etc.).

User Charges - City of Arvada - Wastewater Control Division

The City of Arvada is just beginning to initiate a program of sampling and measuring the wastes from selected industries as the basis for charging all users according to their load on the system.

City of Arvada personnel have recently completed an extensive analysis of all non-residential users of the wastewater system and have begun to compile detailed information on the respective function, type of product, and potential loading of materials to the system.

In 1972, the City of Arvada had an estimated 15,607 sewer taps. Of these, 15,218 were residential and 389 were classified as commercial. The initial survey by the City staff, which included an analysis of all 389 "commercial" establishments, found that 17 of these firms should be classified as "industrial" and further, that 4 of these industries were currently contributing loads to the system in excess of "normal domestic sewage." These four industries are being placed on a sampling program and city personnel are currently developing guidelines for "normal domestic sewage" and user charge recovery from these industries, based on their excessive loadings.

The City of Arvada owns, operates and maintains a secondary wastewater treatment facility which handles a portion of its total sewage demands. As shown in Table 30, the Arvada treatment facilities handled about 330 million gallons of sewage in 1973, which contained 335 tons of BOD and 414 tons of SS. The major portion of Arvada's total

Table 30

TOTAL FLOW AND LOADINGS
City of Arvada
1972

	FLOW (millions of gallons)	BOD ppm	BOD (tons)	SS ppm	SS (tons)
Arvada Treatment Facilities	330.7	243	335	300	414
Direct to MDSDD #1	1,672.0	187	1,303	237	1,651
Total	2,002.7	196	1,638	247	2,065

Source: City of Arvada and MDSDD #1.

wastewater volumes goes directly to MDSDD #1 for treatment.

The portion going to MDSDD #1 in 1972 amounted to 1,672 million gallons of flow, with 1,303 tons of BOD and 1,651 tons of SS. Therefore, Arvada's treatment facilities processed only approximately 16.5% of the flow, 20.5% of the BOD and 20.0% of the SS.

Table 31 reflects the total cost allocated to the operation of the sewerage system within the City of Arvada. These costs were broken down in the same manner as previously for North Table Mountain and North Washington Street, showing administration, operations and maintenance, treatment and disposal, and fixed capital. The total operating cost for the entire system in 1972 was $444,968, of which 67.1% was attributable to treatment and disposal, 6.3% to fixed capital, 21.2% to operations and maintenance, and 5.3% to overall general administration.

Since the City of Arvada has no existing industrial user charge formula and has not yet developed historic flow, BOD and SS readings for industries, it was not possible to determine current and estimated industrial user costs and charges based upon loadings to the system, as could be computed for the North Table Mountain and North Washington Street Districts. However, it was possible to proceed with the analysis and calculations of the total and unit user charges by various functions. Tables 32 and 33 indicate these computations in the same manner as performed for the other two districts. Administrative costs were divided equally among all users, resulting in an annual charge of only $1.52 per user. This primarily is a reflection of economies of scale in the large numbers of users versus the relatively small increase in administrative costs per user.

Taking these unit costs for flow, BOD and SS, based on the alternate formulas discussed previously, it was possible to determine the applicable charge per 1000 gallons of flow, with a base effluent content, as shown in Table 34. Since Arvada has not yet developed standard BOD and SS levels for "normal domestic sewage," the factors which were used reflect the average levels of BOD and SS which were measured as influent into the treatment facilities of the City of Arvada and those which were measured on that portion flowing direct to MDSDD #1 (see Table 30). Average BOD was 196 ppm and SS was 247 ppm. On this basis, as shown in Table 34, calculations produced a processing charge of approximately 21¢ per 1000 gallons. That is, for each 1000 gallons of sewage pumped through the system, based on assumed levels of content and known total operational costs, it will cost approximately 21¢ per 1000 gallons in total charges to cover the total cost of operation.

Table 31

WASTEWATER COSTS BY FUNCTION
1972

Cost Category	Administration	Operations and Maintenance	Treatment and Disposal	Fixed Capital	Total
Personal Services	$13,988	$66,095	$32,399		$112,482
Sewer Charges (MDSDD)			243,966		243,966
Employee Retirement	1,049	4,957	2,430		8,436
Employee Insurance	327	2,545	1,247		4,119
Chemicals		1,200	4,400		5,600
Power and Heat			3,800		3,800
Telephone			288		288
Supplies	2,025		550		2,575
Other Contractual			2,251		2,251
Maintenance	25	12,864	5,970		18,859
Equipment		5,800	1,100		6,900
Fuel and Oil		1,000	200		1,200
Dues and Subscriptions	25				25
Capital Expenditures				$28,217	28,217
Bond Principal and Interest					
Data Processing	6,250				
	$23,689	$94,461	$298,601	$28,217	$444,968

Note: Also classified as Capital Expenditures was $75,000 for sewer mains in Far Horizons development. These are being recaptured through tap charges and are not included. Also there was $149,305 in debt service; $64,130 in payment to Westminister for the Far Horizon system being repaid through special assessment to property owners and $85,175 on bond principal and interest being repaid through a mill levy. These are not included since repayment is already being captured through other sources.

Source: City of Arvada, Department of Public Works

Table 32

CALCULATION OF TOTAL AND UNIT USER CHARGES
BY FUNCTION
(Based on MDSDD #1 Allocation Formula)
Arvada Wastewater Control
1972

1.	ADMINISTRATIVE EXPENSE (spread evenly among users)		
	Administrative expense		$23,689
	Total Users		15,607
2.	OPERATIONS AND MAINTENANCE EXPENSE (per unit flow)		
	Operations and Maintenance expense		$94,461
	Total annual flow (millions of gallons, 1972)		2,003
3.	TREATMENT AND DISPOSAL EXPENSE (Flow, BOD & SS)		
	Total Treatment and disposal expense		$298,601
	Allocation of Expense:		
	Flow	= 45.5%	135,863
	BOD	= 30.9%	92,268
	SS	= 23.6%	70,470
	(Source: MDSDD #1)		
4.	FIXED CAPITAL (Flow, BOD and SS)		
	Total annual fixed capital		$28,217
	Allocation of Expense:		
	Flow	= 45.5%	12,839
	BOD	= 30.9%	8,719
	SS	= 23.6%	6,659
	(Source: MDSDD #1)		
5.	TOTAL UNIT COSTS PER USER AND PER UNIT FLOW, BOD AND SS.		
	Administrative Unit Costs (per user)		
	Administration		$1.518
	Flow Unit Costs (per 1,000 gallons)		
	Administration		$0.000
	Operations and Maintenance		0.047
	Treatment and Disposal		0.068
	Fixed Capital		0.006
	Total per 1,000 gallons		$0.121
	Biochemical Oxygen Demand (BOD) unit costs (per ton)		
	Administration		$0.000
	Operations and Maintenance		0.000
	Treatment and Disposal		56.330
	Fixed Capital		5.323
	Total per ton		$61.653
	Suspended Solids (SS) unit costs (per ton)		
	Administration		$0.000
	Operations and Maintenance		0.000
	Treatment and Disposal		34.126
	Fixed Capital		3.225
	Total per ton		$37.351

Table 33

CALCULATION OF TOTAL AND UNIT USER CHARGES
BY FUNCTION
(Based on WS&A Allocation Formula)
City of Arvada
1972

1.	ADMINISTRATIVE EXPENSES (spread evenly among users)		
	Administrative expense		$23,689
	Total users		15,607
2.	OPERATIONS AND MAINTENANCE EXPENSE (per unit of flow)		
	Total operations and maintenance expense		$94,461
	Total annual flow (millions of gallons)		2,003
3.	TREATMENT AND DISPOSAL EXPENSE (flow, BOD, SS)		
	Total treatment and disposal expense		$298,601
	Allocation of expense:		
	Flow	= 30%	89,580
	BOD	= 40%	119,441
	SS	= 30%	89,580
	(Source WS&A)		
4.	FIXED CAPITAL (Flow, BOD & SS)		
	Total fixed capital expense		$28,217
	Allocation of Expense:		
	Flow	= 45.5%	12,839
	BOD	= 30.9%	8,719
	SS	= 23.6%	6,659
	(Source MDSDD #1)		
5.	TOTAL UNIT COSTS PER USER AND PER UNIT FLOW, BOD AND SS		
	Administrative Unit Cost (per user)		
	Administration		1.518
	Flow Unit Cost (per 1,000 gallons)		
	Administration		$0.000
	Operations and Maintenance		0.047
	Treatment and Disposal		0.045
	Fixed Capital		0.006
	Total per 1,000 gallons		$0.098
	Biochemical Oxygen Demand (BOD) unit costs (per ton)		
	Administration		$0.000
	Operations and Maintenance		0.000
	Treatment and Disposal		72.919
	Fixed Capital		5.323
	Total per ton		$78.242
	Suspended Solids (SS) unit costs (per ton)		
	Administration		$0.000
	Operations and Maintenance		0.000
	Treatment and Disposal		43.380
	Fixed Capital		3.225
	Total per ton		$46.605

Table 34

APPLICABLE CHARGE PER 1000 GALLONS FLOW
WITH BASE EFFLUENT CONTENT

City of Arvada
1972

Given:

Flow = 1,000 gallons
BOD* = 196 ppm or .000818 tons
SS = 247 ppm or .001031 tons

Cost per 1,000 gallons based on MDSDD #1 allocations:

Flow = $0.121
BOD = 0.050
SS = 0.038
Total = $0.209 per 1,000 gallons

Cost per 1,000 gallons based on WS&A allocation:

Flow = $0.098
BOD = 0.064
SS = 0.048
Total = $0.210 per 1,000 gallons

* Factors derived: ppm x 8,345 ÷ 2000 ÷ 1000 = tons/1000 gallons.

Note: Assumed levels of BOD (196 ppm) and SS (247 ppm) are those levels measured as influent at the Arvada treatment plant and by MDSDD #1, (see Table 30). No assigned levels have been determined for "normal domestic sewage."

Based on these calculations, Table 35 was developed to determine the total estimated operational surplus/deficit for expenses vs. revenue, as well as the difference found between the calculated and the actual charges for each of the two user classes.

Total revenue in 1972 was $430,845, while expenses for that period totalled $444,968, resulting in an actual deficit of $14,123 in the wastewater division operation. Total estimated user charges, based on equitable cost allocation derived in Tables 32-34, would have resulted in revenues of $444,263, a deficit of $705 as related to expenses. Calculated revenues should equal expenses, (i.e., no deficit); the difference is due to rounding in the formulae steps.

When evaluating the relative cost absorptive factors for each user class, residential users actually paid almost $9,000 more than would have been paid through the caluclated user charge formula. Commercial and industrial users were charged on the same rate basis, with no relationship to system loadings, so that certain industrial users, probably in particular those 4 firms now singled out for the sampling program, paid significantly less than would have been the case under an equitable user charge allocation procedure.

The calculated residential contribution would have resulted in an average customer charge of $25.88 per year, or $2.16 per month, as opposed to the current typical monthly charge of $2.23 for customers within the district and $4.03 per customer outside the district.

The accounting and cost allocation procedures of the City of Arvada for wastewater functions are basically complete and reliable and are appropriate for distribution in user charge allocations. Procedures for industrial classification and sampling are now underway, as well as a revision in the user charge schedule which will levy equitable user charges based on the system contributions of the user.

It may be concluded through this analysis, using the assumptions inherent in that analysis, that while the City of Arvada is not now in compliance with current federal user charge/industrial cost recovery guidelines, positive and progressive steps are being taken by the City to establish equitable user charges and achieve full compliance.

Table 35

ESTIMATED AND ACTUAL CHARGES BY USER CLASS

City of Arvada

	Number	Estimated User Charges	Actual Charge	Difference	%
Residential	15,218	$393,841	$402,830	+$8,989	+2.2
Commercial[1]	389	50,422	28,015	-22,409	-80.0
TOTAL	15,607	444,263	$430,845	-13,418	-3.1
Expenses		$444,968[2]	$444,968		
Deficit		$ 705	$ 14,123		

Residential based on annual charge of $1.52 plus usage at 116,000 gallons per year with a processing cost of $0.210 per 1000 gallons.

Commercial based on an annual charge of $1.52 plus usage at 610,000 gallons per year with a processing cost of $0.210 per 1000 gallons.

(1) Includes all other users including industrial.

(2) Represents total expenses for 1972(See Table 31).

SECTION VI

INDUSTRIAL COST RECOVERY

Recovery of Grant Funds

Wastewater agencies which apply to the United States Environmental Protection Agency for construction grants for waste treatment facilities are subject to the prerequisites that provision has been made for payment to the applicant by industrial users of that portion of the federal construction grant allocable to the treatment of industrial wastes. Accordingly, the burden of paying for that portion of the facility capacity allocable to industry demand must be borne by all industrial users. The rationale behind this requirement is the prevention of federal subsidies to industry; any other approach would be considered to discriminate against those industries which, for whatever reason, were unable to utilize a publicly-owned treatment works.

The main characteristics of this industrial cost recovery requirement are outlined below.

1. Cost recovery shall take into account all of those factors significantly influencing the cost, such as strength, volume and flow characteristics.

2. Industrial user share of allocable costs shall be adjusted depending on:

   (a) Changes in strength, volume or delivered flow rate;

   (b) Proportionate industrial share of the cost of expanding or upgrading of the treatment works.

3. Industrial share of facility cost shall not include any portion of the grant amount allocable to unused or unreserved capacity.

4. Conversely, the industrial share of facility cost shall include the cost of allocable or reserved capacity as a result of any firm committment to the grantee of increased use by such user.

5. Industrial users will be required to pay their share on an annual or more frequent schedule, exclusive of interest, on the basis of the total allocable costs divided by the useful life of the facility in years, or 30 years, whichever is less.

Preceding page blank

Determination of the actual proportion of total facility cost can be accomplished at several levels of detail. Ideally, the wastewater contribution of each user could be allocated to each treatment function, and the cost of providing that function then be apportioned directly back to each user. Approaching the problem at this level of detail requires extensive knowledge of system requirements and operations, as well as detailed cost analyses which could change significantly over the period, requiring complex and costly adjustments in developing and maintaining cost allocations. Recognizing these difficulties, the EPA regulations place a minimum requirement as a cost recovery guideline:

> "As a minimum, an industry's share shall be based on its flow versus treatment works capacity except in unusual cases."

This, in effect, could permit the industrial user share to be computed on the same basis as for other users if the content of industrial wastes is found comparable to that of normal domestic users. Such a finding is quite unlikely and, unless documented, would doubtless be considered to result in industry grossly underpaying its share under the guidelines. On the other hand, where detailed loading and content data are not immediately available, the method does provide a means of approximating proportional responsibility, and may be acceptable on an interim or transitional basis.

Another factor which must be considered by the various wastewater treatment agencies is that the EPA requirement for capital cost recovery applies only to the extent attributable to the federal share and only to the portion of costs allocable to the treatment of industrial wastes. Certain costs are ineligible under EPA regulations but may be included by the grantee at the grantee's option.

Ineligible costs include land, pre-treatment and collection sewers. As part of the determination of those facility costs attributable to indutry, certain usage characteristics must be considered. Many industries do not operate on a continuous basis. That is, some industries are seasonal while others may place peak demands on the system during certain hours of the day. Proper allocation of capital costs must take into account these peak use characteristics, as they represent important elements both to the design, and therefore, cost of the facility and to the allocation of utilization. Peaking or peak demand characteristics can cause severe problems in treatment operation in terms of overloading and may result in inadequate treatment. Approaches to considering these problems must be included in cost apportionment.

Another point apparent in the regulations is that, to meet EPA requirements, the total industry share must be recovered. An industrial user's share shall be based on all factors which significantly influence the cost of the treatment works.(8)

Obviously, the fairness of the allocation among industries is a function of the application of data each wastewater agency maintains concerning the flow, volume and loadings of each industry. As in the case of user charge allocations in the North Washington Street Water and Sanitation District, a similar approach can be used to determine an equitable level of grant recovery. In this case, it would be necessary to split the project costs according to those which should be distributed evenly and those which are allocable to the variable components of demand.

Hypothetical Example for Recovery of Grant Funds

In order to more easily assess the impacts and requirements of the EPA guidelines as they relate to industrial cost recovery, a hypothetical example was developed to show the various relationships.

Table 36 shows the determination of allowable costs, examples of ineligible costs, and grant funding available. In this example, of the total project cost of $500,000, $100,000 are ineligible for grant funding.

Carrying further the evaluation of what is included in eligible costs, Table 37 reflects a more complete breakdown in what can be considered for grant funding. Since it is assumed that the grant will cover 75% of total eligible costs ($300,000 of $400,000), each category was proportioned equally.

In order to determine the proportion of capital cost chargeable to industrial users, it is then necessary to determine the portion of costs attributable to each function (flow, BOD and SS). Table 38 shows an assumed cost allocation of grant fund items to each category. In this example, costs related to flow account for 54.2% of the total, BOD at 35.8% and SS at 10%. This analysis allows the computation of the industrial share based on loadings to the system and measurement of their contribution.

Certain assumptions were required to carry forward this hypothetical example. Table 39 sets forth these basic assumptions, allocating 22.8% to flow costs, 43.5% of BOD costs and 75.4% of SS costs to industrial users. Therefore, it will be necessary to recover these relative costs from new and existing industries which contribute to the total system.

Table 36

DETERMINATION OF ALLOWABLE COSTS AND PL 92500 GRANT

Example of Treatment Facility Capital Costs
Chargeable to Industrial Users

COST CATEGORY		AMOUNT
1. Project Cost		$500,000
2. Ineligible costs[1]		
Land	$50,000	
Pre-Treatment	$20,000	
Collection Sewers	$30,000	$100,000
3. Eligible Costs		$400,000
4. PL 92500 Grant @ 75 percent		$300,000

(1) The conditions of the grant require that the portion of the grant ascribed to industry must be recovered. Regulations neither require or in any way limit the recovery by the specific agency of certain ineligible costs such as land, pre-treatment or collection sewers.

Table 37

ELIGIBLE AND INELIGIBLE PROJECT COST ITEMS
TOTAL AND GRANT PORTION

Example of Treatment Facility Capital Costs Chargeable to Industrial Users

Cost Item	Total	Allocable to Grant
Intercepting Sewers	$127,000	$95,250
Treatment Plant		
Main Pumping Station		
Equipment	5,600	4,200
Structures	4,400	3,300
Screen and Grit Chambers	5,600	4,200
Preliminary Sed. Tanks	16,400	12,300
Trickling Filters	109,000	81,750
Final Sed. Tanks	32,800	24,600
Recirculation Pumps	2,800	2,100
Chlor. Tanks and Equip.	7,200	5,400
Dig. Tanks and Vac. Filters	29,200	21,900
Subtotal	$340,000	$255,000
Main Control Bldg.	27,200	20,400
Plant Water Supply	9,200	6,900
Roads and Grounds	9,200	6,900
Plumbing and Heating	14,400	10,800
TOTAL ELIGIBLE COSTS	$400,000	$300,000
Ineligible Costs		
Land	$50,000	
Pre-Treatment	20,000	
Collection Sewers	30,000	
TOTAL PROJECT COSTS	$500,000	

Note: Since it is assumed that 75 percent of the eligible project costs will be grant funds, the eligible costs were proportioned evenly.

Table 38

GRANT PROJECT ITEMS ALLOCATED TO FLOW, BOD AND SS
(Example)

Project Item	Cost Allocation Item						TOTAL
	Flow		SS		BOD		
	%	Amount	%	Amount	%	Amount	
Intercepting Sewers	100.0	$95,250					$95,250
Treatment Plant							
Main Pumping Station							
Equipment	100.0	4,200					4,200
Structures	100.0	3,300					3,300
Screen and Grit Chambers	60.0	2,520	40.0	$1,680			4,200
Preliminary Sed. Tanks	85.0	10,460	15.0	1,840			12,300
Trickling Filters	10.0	8,200			90.0	$73,550	81,750
Final Sed. Tanks	50.0	12,300			50.0	12,300	24,600
Recirculation Pumps					100.0	2,100	2,100
Chlor. Tanks and Equip.	40.0	2,160			60.0	3,240	5,400
Dig. Tanks and Vac. Filters			100.0	21,900			21,900
Subtotal	54.2	$138,390	10.0	$25,420	35.8	$91,190	$255,000
Main Control Bldg.	54.2	11,060	10.0	2,040	35.8	7,300	20,400
Plant Water Supply	54.2	3,740	10.0	690	35.8	2,470	6,900
Roads and Grounds	54.2	3,740	10.0	690	35.8	2,470	6,900
Plumbing and Heating	54.2	5,850	10.0	1,080	35.8	3,870	10,800
Subtotal	54.2	$24,390	10.0	$4,500	35.8	$16,110	$45,000
TOTAL GRANT AMOUNT		$162,780		$29,920		$107,300	$300,000

Source: Wilbur Smith and Associates and Equitable Recovery of Industrial Waste Treatment Costs in Municipal Systems, E. P. A., October, 1971.

Table 39

ASSUMPTIONS

Example of Treatment Facility Capital
Costs Chargeable to Industrial Users

1. The plant runs at 90 percent capacity.

2. There is no reserved capacity.

3. On the basis of flow, industry is responsible for 22.8 percent of flow costs.

4. Industry is responsible for 43.5 percent of BOD processed on an annual basis.

5. Industry is responsible for 75.4 percent of the SS processed on an annual basis.

Finally, Table 40 shows the dollar amounts which must be regained, both in total and annually based on expected useful life of the facility. Of the total $500,000 dollar facility cost, $400,000 are costs eligible for grant consideration. Based on a 75% grant ($300,000) and assumed industrial contributions, $95,700 must be recovered from industrial users. Based on the expected useful life of the facility, this results in a user charge repayment by industry of $3,190 per year.

No attempt is made herein to describe the procedures for local retention of portions of the industrial cost recovery, or the uses which must be made of the retention. These matters are adequately covered in the federal guidelines.

Relating Example to Local District

In order to more clearly structure such a hypothetical example of cost recovery, and in order to relate the overall impact on user charges, these circumstances will be related to a local district. Since North Table Mountain Water and Sanitation District is relatively new, is rapidly expanding, and currently has no treatment facilities, it was selected to project revenue changes which sould occur under such a capital improvement program.

The hypothetical example is that of constructing a secondary treatment facility, capable of handling all wastewater from the district users, and thus eliminate discharge to MDSDD #1. Current users and system loading will be taken from the previous report section detailing NTMW&SD user charges and cost allocations. Table 41 indicates the existing circumstances and the future conditions assumed to exist when the "treatment facility" is completed.

Overall,system users will total 1,627 contributing 645 mg. of flow, containing 515 tons of BOD and 712 tons of SS. This results in an average annual daily flow of 1.77 mg. Assuming the proposed plant will operate at 90 percent of capacity, average capacity required would be 1.97 mg. per day. To design the plant for peak day characteristics will require a design capacity of 2.95 mg. per day. Assuming an average construction cost of $170,000 per million gallons per day, total capital costs would be $500,000. This relates directly back to the previous analysis on the hypothetical cost recovery apportionments for capital grants.

Also, note that under the assumed future situation shown in Table 41, industry will account for 22.8% of the flow, 43.5% of the BOD and 75.4% of the SS. This also agrees with the allocation ratios for cost described earlier.

Table 40

GRANT RECOVERY FROM INDUSTRY

Example of Treatment Facility Capital Costs
Chargeable to Industrial Users

Flow Charges - Grant Portion:

Flow Capital Costs	=	$162,780
Percent of Plant Used (90%)	=	146,500
Percent Industrial (22.8%)	=	33,400
Useful Life (30 yrs.)	=	1,113/yr.

BOD Charges:

BOD Capital Costs	=	$107,300
Percent of Plant Used (90%)	=	96,570
Percent Industrial (43.5%)	=	42,000
Useful Life (30 yrs.)	=	1,400/yr.

SS Charges:

SS Capital Costs	=	$ 29,920
Percent of Plant Used (90%)	=	26,900
Percent Industrial (75.4%)	=	20,300
Useful Life (30 yrs.)	=	677/yr.

TOTAL:

	Flow	$ 1,113
	BOD	1,400
(annual)	SS	677
		$ 3,190

Note: Percent Industrial refers to the percentage of flow attributable to industry, not percent of plant capacity.

Table 41

CURRENT AND ASSUMED SYSTEM
North Table Mountain Water and Sanitation District

TYPE USER	NUMBER - 1972	1972 FLOW mg	1972 BOD Tons	1972 SS Tons	FUTURE NUMBER ASSUMED	FUTURE FLOW mg	FUTURE BOD Tons	FUTURE SS Tons
Residential	467	142	83	50	1600	488	285	171
Commercial	10	5	3	2	20	10	6	4
Industrial	3	63	68	250	7	147	224	537
TOTAL	480	210	154	302	1627	645	515	712

Note: 1972 loadings reflect final apportionment of MDSDD #1 totals among user classes. This resulted in BOD levels of 140 ppm for residential and 144 ppm for commercial; SS levels were 84ppm residential and 96 ppm commercial. Residential flow at 305,000 gallons/yr; commercial flow at 500,000 gallons/yr. Current industrial users remain the same on Flow, BOD and SS levels. Four new industries usage and load shown in the following table. These are not levels of "normal domestic sewage." See Section V for further explanation.

Source: The North Table Mountain Water and Sanitation District
Future assumptions by Wilbur Smith and Associates.

It was assumed that four additional industries would discharge wastes to the system. Table 42 shows a breakdown of these industries, giving assumed flow, BOD and SS content. This calculation also would allow for proper apportionment of capital grant recovery charges to appropriate industries.

In order to determine revised user charges for all user classes, it was necessary to project possible costs, broken down by operational function, as shown in Table 43. Note that treatment and disposal costs have increased somewhat even though there are no longer any direct charges from MDSDD #1. Also, the $23,100 fixed capital charges reflect the annual portion of debt service necessary to recover capital cost expenditures in excess of the $300,000 grant funds; the remaining $200,000 is amortized at an interest rate of approximately 5 3/4% over a 15 year period. This results in the average annual repayment of $23,100.

Taking the total costs per function and allocating this to flow, BOD and SS, unit costs were developed as indicated in Table 44. Allocation of treatment and disposal costs are the same as used earlier in the report (Section V). Allocation of fixed capital costs are those projected for the construction of this hypothetical treatment plant earlier in this section.

Based on these unit costs and estimated industry loadings, charges for industrial users were calculated. The seven industries would be required to pay a total of about $27,000 to cover their contribution for system loadings, as shown in Table 45.

In order to determine appropriate residential and commercial charges, development of a per 1000 gallon charge (containing base effluent levels) was necessary. Using the alternate allocations of previous examples, this resulted in a necessary charge of $.080 per 1000 gallons for residential users and $.081 per 1000 gallons for commercial users. The derivation of these ratios is shown in Table 46.

Utilizing the applicable charges developed in Table 46, and assuming certain levels of flow for residential and commercial users, estimated charges were developed. Industrial charges from Table 45 were added to determine total applicable charges. These estimated charges are adequate to cover total operating expenses, as indicated in Table 47.

Also shown in Table 47 is the combination of industrial user charges and capital grant recovery charges to determine the total industrial obligation to cost recovery. These charges should be apportioned to each industry based on each industry's contribution to the system.

Table 42

FUTURE INDUSTRIAL USERS
ASSUMED EFFLUENT LEVELS

	Flow	BOD		SS	
	mg	ppm	tons	ppm	tons
Industry A	14	400	23	1200	70
Industry B	28	300	35	600	70
Industry C	25	600	63	800	83
Industry D	17	500	35	900	64
TOTAL	84		156		287

Source: Wilbur Smith and Associates

Table 43

ASSUMED COSTS BY FUNCTION
North Table Mountain Water and Sanitation District
(In 1972 Dollars)

COST CATEGORY	FUNCTION: ADMINISTRATIVE	OPERATIONS & MAINTENANCE	TREATMENT AND DISPOSAL	FIXED CAPITAL	TOTAL
Salaries	$4,000	$2,000	$20,000		$20,000
Engineering	2,000	2,000	6,000		10,000
Maintenance		2,300			2,300
Power-Water	200		4,600		4,800
Telemetering			200		200
Auto Costs		600			600
Tools		800	800		1,600
Lab Analysis			2,100		2,100
Audit Fee	200				200
Director's Fee	1,600				1,600
Legal Fees	800				800
Insurance	150		1,000		1,150
Dues	50				50
Printing and Misc.	200				200
Office Rent	300				300
Office Supplies	200				200
Payroll Taxes	200	100	1,200		1,500
Telephone	100		100		200
Capital Expenditures (non-grant portion)				$23,100	23,100
TOTAL	$10,000	$7,800	$36,000	$23,100	$76,900

Table 44

ASSUMED TOTAL AND UNIT USER CHARGES

North Table Mountain Water and Sanitation District

1.	ADMINISTRATIVE EXPENSES		
	Administration expense		$10,000
	Total users		1,627
2.	OPERATIONS AND MAINTENANCE EXPENSE		
	Total operations and maintenance expense		$ 7,800
	Total annual flow (mg)		645
3.	TREATMENT AND DISPOSAL EXPENSE		
	Total treatment and disposal expense		$36,000
	Allocation of expense:		
	Flow	= 30.0%	10,800
	BOD	= 40.0%	14,400
	SS	= 30.0%	10,800
4.	FIXED CAPITAL EXPENSE		
	Total annual fixed capital expense		$23,100
	Allocation of expense:		
	Flow	= 54.2%	12,520
	BOD	= 35.8%	8,270
	SS	= 10.0%	2,310
5.	TOTAL UNIT COSTS PER USER AND PER UNIT FLOW, BOD AND SS		
	Administrative Unit Costs (per user)		$6.15
	Flow Unit Costs (per 1,000 gallons)		
	Administration		$0.000
	Operations and Maintenance		0.012
	Treatment and Disposal		0.017
	Fixed Capital		0.019
	TOTAL		$0.048
	BOD Unit Costs (per ton)		
	Administration		$0.000
	Operations and Maintenance		0.000
	Treatment and Disposal		27.961
	Fixed Capital		16.058
	TOTAL		$44.019
	SS Unit Costs (per ton)		
	Administration		$0.000
	Operations and Maintenance		0.000
	Treatment and Disposal		15.169
	Fixed Capital		3.244
	TOTAL		$18.413

Table 45

CALCULATED CHARGES FOR INDUSTRIES
BASED ON ASSUMED CONDITIONS

North Table Mountain Water and Sanitation District

TYPE OF CHARGE	QUANTITY	RATE	AMOUNT
Administration	7	$6.15	$43.00
Flow (mg)	147	$48.00	7,056.00
BOD (ton)	224	$44.02	9,860.00
SS (ton)	537	$18.41	9,890.00
Total Calculated Charge			$26,849.00

Table 46

APPLICABLE CHARGE PER 1,000 GALLONS FLOW
BASED ON CONTENT AND FLOW ASSUMPTIONS

North Table Mountain Water and Sanitation District

Given:

Flow = 1,000 gallons
BOD* = residential - 140 ppm or .000584 tons/1000 gallons
commercial - 144 ppm or .000601 tons/ 1000 gallons
SS = residential - 84 ppm or .000350 tons/1000 gallons
commercial - 96 ppm or .000401 tons/1000 gallons

Cost per 1000 gallons -

	Residential	Commercial
Flow	$0.048	$0.048
BOD	0.026	0.026
SS	0.006	0.007
TOTAL	$0.080	$0.081

* Factors derived: ppm x 8.345 ÷ 2000 ÷ 1000 = tons/1000 gallons

Note: BOD and SS levels should not be construed as "normal domestic sewage," but merely apportioned factors relating to NTMWSD only. See Section V for further explanation.

Table 47

ESTIMATED CHARGE FOR ALL USERS
BASED ON ASSUMED CONDITIONS

North Table Mountain Water and Sewer District

TYPE USER	NUMBER	ESTIMATED CHARGE
Residential	1600	$48,752
Commercial	20	933
Industrial	7	26,849
TOTAL	1627	$76,534
Actual Expenses		$76,900

Note: Residential based on a per user charge of $6.15 plus a cost of $0.080 per 1000 gallons and a usage of 304,000 gallons. Commercial based on a per user charge of $6.15 plus a cost of $0.081 per 1000 gallons and a usage of 500,000 gallons. Industrial from Table 45.

Total Industrial User Charges Based on Assumed Conditions

North Table Mountain Water and Sanitation District

Industrial User Charges	$26,849
Capital Grant Recovery Charges	3,190
TOTAL	$30,039

Average residential monthly charges under the existing system and cost allocations were estimated to be about $5.00 (see Section V), but are only about $2.50 under the hypothetical situation; the average charges to each industry were calculated to be about $6,700 per year under existing practices but are only $3,835 under the hypothetical example. This alone should not be construed as justification for such a capital improvement program. Total costs could vary considerably from those assumed in the example, and correspondingly affect operating expenses. Also, lower user charges may also be directly related to economies of scale; for example, lower administrative costs per user may occur as the number of users increases without capital improvement expenditures of this type. In fact, the "savings" may be even greater if large scale capital expenditures were foregone. Any specific situation must be evaluated on its own merits, utilizing far more sophisticated cost allocation and cost estimation techniques than were necessary for this "broad-brush" hypothetical example to be used only for procedural evaluations and formulation.

Industrial Allocation of Capital Grant Recovery Charges

In order to better assess the impact of future charge schedules on each participating industry it is necessary to carry our examples one step further. Instead of 7 industries to come on-line when the plant opens as shown in the previous section, only the 3 existing industries will be included for Year 1 of operation. The 4 additional industries will come on the system in Year 2. Therefore, Year 2 in this example closely approximates the situation in the previous example, "Relating Example to Local District."

The following assumptions are made:

1. The treatment facility is constructed during future Year X and when coming on-line has 1600 residential users, 20 commercial users and 3 industrial users. These industries account for 8.8% of capacity flow, 11.9% of BOD and 31.6% of SS (the same as existing industries shown in Table 41).

2. Costs and grant recovery portions are as shown in Tables 36 - 38.

3. The following year, 4 additional industrial users join the system having the discharge characteristics shown in Table 42.

4. Costs will remain the same as shown in Table 43 for both years.

Table 48 reflects the loading characteristics of the 3 industries on-line when the facility opens (Year 1). Each industry's share of flow, BOD and SS are computed to determine the relationship each should bear to the repayment of the appropriate portion of the federal grant which must be recovered. Note that these total loadings relate to the numbers derived in Table 41 and earlier in Section V. Also shown is the amount of the capital grant recoverable based on their proportionate contribution to the system for flow, BOD and SS. This total of $36,547 represents 12.2% of the total capital grant.

Table 49 takes these percentage relationships for the 3 industries and applies them to the recoverable total charge for each loading breakdown. The total annual charge and the breakdown for the applicable recovery attributable to flow, BOD, and SS are the same as derived in Table 48. This results in Industry 1 having an obligation of $644, Industry 2 having an obligation of $182 and Industry 3 having an obligation of $392. This recovers the total annual grant recovery charge of $1,218 equitably from each industry based on its contribution to the system.

Following the hypothetical assumptions further, during the next year (Year 2) four new industries are constructed and come on the system. Table 50 details the flow, BOD and SS contributions of each of the seven industries now on the system. These are the same as assumed for initial operation in the previous example, "Relating Example to Local District"). The new percentage relationships are now computed to determine each industry's new relative portion of industrial load on the system. Industry 1, for example, contributed 60.4% of the total industrial flow during Year 1, but only 25.9% during Year 2. The recoverable portion of the capital grant now increases to 32.0% of the total, representing industry's increasingly proportionate share of system usage.

These new percentage relationships can now be applied to the amount of capital grant required to be recovered. Table 51 reflects these reallocations in Year 2. Note that the total amount to be recovered and each sub-amount related to flow, BOD and SS are not the same as shown in Table 49 (Year 1 recovery). The total (and annual) amount subject to recovery must be recomputed each year based on total industrial contribution during the 30 year period (or life of the project), based on new industries beginning service, industries going off-line and changes in flow, BOD and SS levels from year to year. In this example, effluent loadings for Industries 1, 2 and 3 were kept constant from Year 1 to Year 2.

This Year 2 reallocation changes the amount paid by existing industry (1, 2 and 3) from $1,218 in Year 1

Table 48

EXISTING INDUSTRIAL USERS
ASSUMED FUTURE EFFLUENT LEVELS

Year 1

Industry	Flow (mg)	%	BOD (tons)	%	SS (tons)	%
1	38	60.4	33	49.0	117	46.7
2	10	16.1	11	16.3	29	11.5
3	15	23.5	24	34.7	104	41.8
TOTAL	63		68		250	
Total Plant Capacity	715		572		791	
Industry % of Plant Capacity	8.8		11.9		31.6	
Total Grant	$162,780		$107,300	$29,920		TOTAL $300,000
Industrial Cost Recovery	$ 14,324		$ 12,768	$ 9,455		$ 36,547
Annual Industrial Cost Recovery (based on 30 years)	$ 477		$ 426	$ 315		$ 1,218

Table 49

ALLOCATION OF CAPITAL GRANT RECOVERY
THREE "EXISTING" INDUSTRIES

Year 1
(Annual Charge)

Industry	Flow %	Flow Charge	BOD %	BOD Charge	SS %	SS Charge	Total Charge
1	60.4	$288	49.0	$209	46.7	$147	$644
2	16.1	77	16.3	69	11.5	36	182
3	23.5	112	34.7	148	41.8	132	392
TOTAL ANNUAL CHARGE[1]		$477		$426		$315	$1,218

(1) See Table 48 for derivation of amounts

Source: Wilbur Smith and Associates

Table 50

FUTURE INDUSTRIAL USERS
ASSUMED EFFLUENT LEVELS

Year 2

Industry	Flow mg	%	BOD Tons	%	SS Tons	%
1	38	25.9	33	14.8	117	21.8
2	10	6.8	11	4.9	29	5.4
3	15	10.2	24	10.7	104	19.4
A	14	9.5	23	10.3	70	13.0
B	28	19.0	35	15.6	70	13.0
C	25	17.0	63	28.1	83	15.5
D	17	11.6	35	15.6	64	11.9
TOTAL	147		224		537	
Total Plant Capacity	715		572		791	
Industry % of Plant Capacity	20.6		39.2		67.9	TOTAL
Total Grant	$162,780		$107,300		$29,920	$300,000
Industrial Cost Recovery	$ 33,533		$ 42,061		$ 20,316	$ 95,910
Industrial Cost Annual (30 years) Recovery	$ 1,118		$ 1,402		$677	$3,197

Note: Industries 1, 2 and 3 from Table 48.

Industries A, B, C and D from Table 42.

Total industrial grant recovery ($3,197) varies slightly from the amount derived in Table 40 due to rounding in percentages.

Source: Wilbur Smith and Associates

Table 51

ALLOCATION OF CAPITAL GRANT RECOVERY
SEVEN "FUTURE" INDUSTRIES

Year 2
(Annual Charge)

Industry	Flow %	Flow Charge	BOD %	BOD Charge	SS %	SS Charges	Total Charge
1	25.9	$290	14.8	$207	21.8	$148	$645
2	6.8	76	4.9	69	5.4	37	182
3	10.2	114	10.7	150	19.4	131	395
A	9.5	106	10.3	144	13.0	88	338
B	19.0	212	15.6	219	13.0	88	519
C	17.0	190	28.1	394	15.5	105	689
D	11.6	130	15.6	219	11.9	80	429
TOTAL(1)		$1,118		$1,402		$677	$3,197

(1) See Table 50 for derivation of amounts.

Source: Wilbur Smith and Associates.

to $1,222 in Year 2. The new industries are required to repay their fair share based on usage and account for the remaining $1,975, for Year 2 operations. The relatively equal amount paid by industries 1, 2 and 3 is a result of retaining flow, BOD and SS quantities the same from Year 1 to Year 2. In reality, as these will change, so will the actual dollars charged.

Table 52 takes this cost recovery procedure through the 30 year period in a general way. Detailed allocations by industry are not computed and the industrial share allocations are arbitrary assumptions. These, in reality, would be computed as shown in Tables 48 - 51 and broken down by individual industry.

As Table 52 shows, the total grant amount ($300,000) remains the same every year. Industry's contribution share is applied to this each year to determine the total amount to be recovered in that year. This is necessary since the total industrial share will probably change from year to year as will each industry's contribution.

If there is no industrial waste discharge, then no recovery is required. For example, during the latter half of the 30 year recovery period portrayed in Table 52, industry began to decline and during the last two years all industries had ceased operations. Therefore, no recovery was required. Industry must pay its share of the system usage, but only that amount.

Over the hypothetical 30 year period, industry would repay 23.5% of the total capital grant, reflecting the weighted proportionate share of industry contribution during this time.

Table 52

HYPOTHETICAL COST RECOVERY SCHEDULE
Industrial Allocation

Year	Industry Share (%)[1]	Total Grant[2]	Industrial Recovery Portion	Annual Payments[3]
1	12.2	$300,000	$36,600	$1,220
2	32.0		96,000	3,200
3	34.8		104,400	3,480
4	31.1		93,300	3,100
5	26.5		79,500	2,650
6	29.0		87,000	2,900
7	32.1		96,300	3,210
8	34.8		104,400	3,480
9	31.6		94,800	3,160
10	40.0		120,000	4,000
11	38.6		115,800	3,860
12	37.5		112,500	3,750
13	31.8		95,400	3,180
14	33.0		99,000	3,300
15	30.0		90,000	3,000
16	27.2		81,600	2,720
17	28.6		85,800	2,860
18	25.0		75,000	2,500
19	26.1		78,300	2,610
20	23.8		71,400	2,380
21	16.5		49,500	1,650
22	17.2		51,600	1,720
23	17.8		53,400	1,780
24	16.0		48,000	1,600
25	11.1		33,300	1,110
26	11.0		33,000	1,100
27	5.0		15,000	500
28	5.4		16,200	540
29	0.0		-0-	-0-
30	0.0		-0-	-0-
TOTAL	23.5	$300,000	---	$70,560

(1) Based on total plant capacity and available unused capacity, maximum industrial contribution would be 41.8% (30.3% flow, 49.1% BOD and 77.9% SS).

(2) Remains the same throughout useful life.

(3) Based on 30 year useful life.

Source: Wilbur Smith and Associates

SECTION VII

PREREQUISITES TO A USER CHARGE SYSTEM

The selection and adoption of a user charge system is not a simple matter. Many diverse factors and considerations influence the formulation of user charges.

Public Acceptance

Not surprisingly, the concept of user charges and industrial cost recovery promulgated by EPA is not universally embraced or even understood. Attitudes concerning user charges may well include the view that it is an "insidious form of taxation," or "in conflict with economic development activities," or "inconsistent with economic principles" (decreasing unit costs). Further, it may be viewed as "dictatorial" or "federal interference in local affairs." All of these views have been reflected in various newspaper accounts from localities across the nation in recent months.

Without debating the relative merits of user charges versus other forms of revenue measures, suffice it to say that a municipality or other agency contemplating the adoption of a schedule of user charges to meet EPA guidelines is advised to conduct an enlightened program of citizen education, provide strong policy leadership, and insure that its proposals are based upon factual, technical information.

Industrial Data

It is simply not possible to develop an equitable and realistic program of industrial user charges without data as to the requirements which industrial users place upon the wastewater system. Typical base data requirements include:

1. Type establishment; principal products
2. Number of employees by work shift
3. Source(s) of water supply
4. Volume of water use
5. Uses of water
6. Type processes utilized
7. Waste disposal points
8. Composition, volume and flow rate of wastes discharged

Preceding page blank

Such data will permit the wastewater agency to identify the potential dischargers of non-domestic wastes, as well as the characteristic magnitude and composition of those discharges. This facilitates the selection of those industries to be included in the sampling program.

To the wastewater agency, a "know your industry" posture is essential to effective wastewater management. Regular personal contacts should supplement technical data collection and sampling programs.

One of the prerequisites to approval of construction grants is a determination by EPA that the applicant "has legal, institutional, managerial, and financial capability to insure adequate construction, operation and maintenance of treatment works." It is not beyond comprehension that an agency failing to develop or employ adequate base data on users and treatment costs may be found to not meet this criterion.

Accounting And Cost Allocation

The preceding study, Institutional and Financial Arrangements for Wastewater Management - Denver SMSA, revealed a wide disparity of accounting practices and a general failure (except among such agencies as MDSDD #1 and City and County of Denver) to maintain a classification of accounts which permitted cost allocation to the various wastewater cost components. This reveals a general variance from guideline requirements that adequate documentation for user charge measures be maintained.

To develop a user charge system to meet EPA guidelines appears to dictate that a separate wastewater "fund" be established within the accounting systems of all agencies; further, that this fund be also broken down into functional account codes such as "administration," "collection system," "pumping," "primary treatment," "sludge disposal," etc. Sub-classifications within these functions should include "salaries and wages," "maintenance and repair," "capital expenditures," debt service," etc.(9) A purely "line item" classification will not produce the necessary information.

Obviously, particularly in the smaller agencies, it is difficult to allocate the time of a work crew or piece of equipment which, in the course of a day or week performs in several functional areas. Yet, it should be possible to develop a relatively simple (if necessary, subsidiary) accounting procedure to allocate costs to the various functions as needed to support and document the user charge derivation. Without this, there is no realistic or equitable way to allocate costs to function or to users.

User Charge Schedule

While the EPA guidelines define "treatment works" to include all physical components of the wastewater system, there are certain capital cost components which may or may not be recovered by user charges. Primary among these are the collection system and the local share of a capital grant program.

The EPA guidelines neither require not prohibit financing the initial installation or subsequent extension of the collection system from user charges. Most wastewater agencies regard the construction of the collection system as of unique special benefit to the property served, and levy a tap charge, frontage charge, or special assessment for connection which is sufficient to recovery of the costs of the extension. For those agencies which operate under this principle, the user charges are then designed only to provide maintenance and repair of the collection system, plus the other cost components of the total wastewater system. The derivation and use of the "plant investment fee," as currently levied by some agencies in the SMSA, may be subject to scrutiny under the established guidelines unless it is based on a "user charge" type allocation to reflect relative system usage.

The local share of a capital grant improvement program may be recovered at the discretion of the local agency. If it is a system-wide improvement affecting all users, equitibility could be achieved by recovery through the user charge system. If it is of special benefit to only a segment of system customers (i.e., a secondary collection system) more equitibility could be achieved by recovery through some type of special assessment to the affected customers.

In some instances in the Denver SMSA, the initial construction or subsequent extension of the collection system is financed by the mill levy. So long as the cost or value of the extension is reflected in enhancement of the value of the property served, this would appear to be equitable and consistent with EPA guidelines. Should industry be afforded preferential treatment, by comparison with other users, in the amount of cost burden levied for main extensions, it is conceivable that EPA would find this practice inconsistent with the guidelines unless it is demonstrated as the most equitable method of allocating costs. On the other hand, financing of treatment facilities and operations by mill levies would almost certainly be inconsistent with the letter and the intent of these guidelines.

The findings of this study do little to support the application of the SIC classifications to either users

or user classes, except as perhaps an interim or transitional measure. Wide variances in waste characteristics among users of the same class are reported by wastewater agencies maintaining sampling/monitoring programs.

Volume, biochemical oxygen demand (BOD) and suspended solids (SS) are the typical measures employed as rate factors in the user charge schedule. In particular circumstances, in particular localities, dissolved solids (DS), chemical oxygen demand (COD), nutrients and other parameters (color, pH, deleterious substances, etc.) may be covered by a rate factor or by standards and prohibitions governing discharges.

Adopting Ordinance

The EPA guidelines require that the user charge schedule be "incorporated in one or more municipal legislative enactments or other appropriate authority," or "ordinances" in conventional terminology. While sanitation districts may not have been granted authority to enact ordinances per se, it is believed that their statutory authority to fix schedules of rates and charges is sufficient to enable these agencies to do so in a manner to satisfy the intent of the guidelines.

In the course of the study, several agencies were identified which fix user charges by negotiated contract with the individual industry, rather than by ordinance. This practice should be examined in the light of the guidelines, both as to form and to content, to insure compliance. It should also be examined in the light of state constitutional or legislative mandates that practices be uniform and equitable among classes.

Of course, no agency is required to enact user charges in the form specified, unless it desires to be eligible to receive federal construction grant funds. The guidelines do require however, that all municipalities or districts which are part of a regional system must have enacted such charges for the regional system to become eligible. The implications of this requirement are discussed elsewhere in this report.

The adopting ordinance, in addition to the user charge schedule, should also establish standards and requirements for waste discharges (See Appendix A for Model Ordinance) and other features of the agency's industrial waste program.

Operating and Management Plan

It is not believed to be in the overall public interest or in the interests of effective wastewater management that the wastewater systems become merely "receivers" of

wastes, levying such charges as may be appropriate under circumstances. Rather, it is believed that each agency should develop an active operating and management plan or strategy for dealing with its industrial users.

For example, the agency should work with its industrial users to alleviate peaking conditions, either hydraulic or chemical, which create added operational costs. Industries might be prevailed upon to cooperatively agree to discharge at off-peak times, or on a staggered schedule, to minimize operational and cost requirements.

Working relationships between the wastewater agency and the individual industries should be such that changes in industrial processes or other changes in demands upon the wastewater system would be made known to the wastewater agency well in advance so that appropriate adjustments could be made.

Both the user charge schedule and the operating plan (as well as the water charge schedule) should encourage pre-treatment and other reductions in waste volumes and concentrations with which the wastewater system must deal. The "know your industry" posture, previously cited, should facilitate a partnership understanding.

Included with the operating and management plan must be an orderly, systematic program for the monitoring of industrial wastes. This program must include physical on-site provisions for gathering samples, laboratory testing and analysis of those samples, a realistic schedule for taking samples, a continuing program of information and data exchange with industrial users, and some "early warning" mechanism to avoid disruption or overloading of treatment plant processes.

Physical provisions may include a requirement for sampling manholes, and may also include a requirement that the industry provide holding tanks for temporary deteration and gradual release of strong wastes. Many agencies vary the frequency of gathering samples in accordance with the strength of the wastes; the greater the strength, the greater the frequency of sampling.

Plan Update

The user charge and industrial cost recovery requirements of the EPA guidelines stipulate periodic (at least annual) update of the user charge schedule to reflect changed conditions.

Ideally, a continuous review and adjustment would be accomplished. However, stability in rate structures

(just as in tax structures) is vital to the economic stability and well-being of commercial and industrial users. To avoid widely-fluctuating rate structures from year to year, the wastewater agency should develop enlightened capital improvement programs and financial policies which anticipate outlays in an orderly fashion, consistent with need but also consistent with revenue considerations.

Transitional Steps

The smaller agencies, in particular, will find it impractical to instantly initiate an industrial waste program. Physical and financial constraints may render this impossible. The guidelines would appear to anticipate and permit this, so long as a definite program of implementation is underway.

For example, until physical arrangements have been made for a sampling program, the wastewater agency might require that industrial users secure laboratory analyses of their wastewater from independent contract agencies, using the lab report as a basis for charges. Alternatively, agencies might jointly staff and equip the necessary industrial waste program, or contract with a larger agency for its performance.

Until accounting classification and cost allocation procedures have been developed, estimates may have to be made of the various cost components of the system. Until individual characteristics of users have been determined, SIC or other classifications may have to be applied.

Finally, until the program and its impact have been fully developed, a deferred effective date might be established. During this period, samplings can be taken, industries can evaluate and provide pre-treatment measures, and cost accounting techniques can be perfected. "Sample" bills might be sent to industrial users during this period. In other localities, marked reductions in loadings have been accomplished when deferred dates or "warning periods" are established. The end result would appear to be completely consistent with national goals and with EPA guidelines and regulations.

SECTION VIII

REGIONAL WASTEWATER AGENCY

Of special concern in the Denver SMSA, particularly in the instance of Metropolitan Denver Sewage Disposal District #1, is the effect of the federal regulations and guidelines upon the eligibility of a regional agency having a number of subscribers. The guidelines specifically state:

> "If a project for which a grant is given is a regional treatment works accepting wastewaters from treatment works owned by others, then the subscribers receiving waste treatment services from the grantee shall have adopted user charge systems in accordance with this guideline.(10)

MDSDD #1 has "Connecting Municipalities" as subscribers who directly discharge waste to MDSDD #1 for treatment and disposal. The Connecting Municipalities have, or may have, "Associated Municipalities" who discharge wastes directly to the system of the Connecting Municipality and, thus, indirectly to MDSDD #1.

The Sewage Treatment and Disposal Agreement (Service Contract) for MDSDD #1 provides that each Connecting Municipality shall be liable for payments, but that no Associated Municipality shall be liable for the payment of any charge of the District for sewage treatment, and disposal; further, that nothing shall prevent the Connecting Municipality from charging the Associated Municipality for accepting its wastes. The Service Contract does not stipulate the form of charges made by either Connecting Municipalities or Associated Municipalities to their respective users.

The question thus arises - how can MDSDD #1 (which levies user charges upon its subscribers and in a form similar to that required in EPA guidelines) insure its continuing eligibility for Federal construction grants?

There is no apparent authorization in either the enabling legislation (Ch. 89, ARt. 15, CRS, as amended), or in the Service Contract, to permit MDSDD #1 to require of its direct or indirect subscribers a particular form of rate structure, or to require the continued adoption of that structure as a condition to continued service.

Several options are open. The Service Contract might be amended to include such a stipulation for both Connecting (direct) and Associated (indirect) municipal subscribers. Presumably, since the welfare of the District is linked to the welfare of the subscribers, subscribers would be receptive to the amendment.

Should this presumption be invalid, however, the only effective recourse perceived is that the State enact legislation requiring that all wastewater agencies adopt and maintain user charges consistent with EPA Regulations and Guidelines. Undoubtedly, this would create some adverse reaction among certain municipalities or other wastewater agencies as unwarranted intervention. This may, further, be found to be in conflict with the terms or constraints of revenue bond resolutions by certain districts, requiring consent of the bond holders.

Granted, however, that by voluntary or by legislative action a basic system of user charges is adopted by municipal and district subscribers, how can MDSDD #1 or other regional agencies insure that these charges remain equitable and current at the time of each application for grant?

It appears inevitable that, in the interest of their members, regional agencies will have to maintain some form of continuous review of cost and revenue structures for all direct and indirect subscribers. Perhaps, this may afford an opportunity for improved economy, efficiency and uniformity through the regional agency performing accounting, billing and user charge derivation services for its members. Authority to undertake these additional services would appear to exist in enabling legislation, and to require only simple contract negotiations.

Considered opinions suggest that by educational or training programs, contractual arrangements, or legislative enactment, regional treatment agencies need to take the initiative if they are to survive the concurrent onthrust of increased wastes and federal regulation.

SECTION IX

ACKNOWLEDGMENTS

The quality and accuracy of a detailed technical study of this type depends to a large degree on the cooperation and availability of reliable data from involved agencies. To this end, response was excellent.

It would be difficult to single out all the individuals who contributed to this effort. Certainly, special thanks must be extended to the personnel of the Metropolitan Denver Sewage Disposal District Number One, particularly Joe Woodley and Jan Henley; the City and County of Denver Wastewater Control Division, especially Horace L. Smith and Bob Gustafson; North Washington Street Water and Sanitation District, particularly Charles Ciancio and Gwen Forbes; North Table Mountain Water and Sanitation District, specifically William Byrne; and the City of Arvada, including Wayne Adams.

Particular recognition should be extended to Mr. George G. Collins, Project Director, U.S. Environmental Protection Agency for his guidance, support and understanding throughout the study. He and other members of E.P.A. provided invaluable assistance in the review and critique of this document.

SECTION X

REFERENCES

1. Federal Register, Volume 38, Number 161, August 21, 1973, "Environmental Protection Agency, Grants for Construction of Treatment Works - User Charges and Industrial Cost Recovery."

2. City of Arvada and North Table Mountain and North Washington Street Water and Sanitation Districts.

3. Federal Register, Volume 38, No. 161, August 21, 1973.

4. MDSDD #1 currently has an in-depth study underway to review the cost allocation percentages to develop more representative values.

5. Sewer Service in Texas Cities, Texas Municipal League. This source showed that the base content of "normal domestic sewage" varied from 200 ppm to 700 ppm for BOD and 200 ppm to 550 ppm for SS. However, most Texas agencies used quantities ranging between 250 - 300 ppm.

6. The 467 users represents an annual coverage; 177 in January increasing to 737 in December.

7. MDSDD #1 currently has an in-depth study underway to review the cost allocation percentages to develop more representative values.

8. It may be assumed that most wastewater agencies (with EPA encouragement) will apply the user charge principle to individual industrial users in obtaining industrial cost recovery. Industrial cost recovery would thus become an extension of the user charge system, with a fixed amount of total "earmarked" revenue to be derived.

9. Manual of Practice, Water Pollution Control Federation. No. 40, "Uniform System of Accounts for Wastewater Utilities."

10. Federal Register, Volume 38, No. 161, August 21, 1973.

Preceding page blank

SECTION XI

BIBLIOGRAPHY

American Public Works Association, American Society of Civil Engineers, Water Pollution Control Federation, Financing Charges for Wastewater Systems, 1973.

American Public Works Association, Industrial - Waste Regulations and Surcharges, 1971.

American Society of Civil Engineers, Section of Municipal Law of the American Bar Association, et al., Fundamental Considerations in Rates and Rate Structures for Water and Sewage Works, 1951.

Arvada, City of, Annual Budget and Program of Services, 1972.

Arvada, City of, "Sewer Service Charges," September, 1972.

Classen, Nicholas W., P.E. and Harry D. Voigt, "The Cost of Wastewater System Facilities," Public Works, May, 1973.

Colorado Interstate Gas Company, Colorado Industrial Capability Register, 1970.

Colorado Municipal League, Municipal Sewer Service in Colorado, 1963.

Denver, City and County of, Department of Public Works, Article 167, Rules and Regulations Governing Sanitary Sewage Charges and Control of Wastewater.

Denver, City and County of, Wastewater Control Division, "Industrial Waste Accounts, Classifications and Loadings," July, 1970 to June, 1971, and July, 1971 to June, 1972.

Environmental Law Institute, Effluent Charges on Air and Water Pollution, 1973.

Environmental Protection Agency, Alternative Financing Methods for Clean Water, 1971.

Environmental Protection Agency, Cost Effectiveness in Water Quality Programs, 1972.

Environmental Protection Agency, Equitable Recovery of Industrial Waste Treatment Costs in Municipal Systems, October, 1971.

Preceding page blank

Environmental Protection Agency, Financial and Institutional Arrangements for Wastewater Management, by Wilbur Smith and Associates, April, 1973.

Environmental Protection Agency, National Capital Region Water and Waste Management Report, April, 1971.

Environmental Protection Agency, The Economies of Clean Water, January, 1972.

Federal Register, Grants for Construction of Treatment Works, User Charges and Industrial Cost Recovery, Volume 38 Number 161, August 21, 1973.

Hyde, J. R., "Inaugurating an Industrial Waste Program," Public Works, March, 1972.

Management and Budget, Office of, Office of the President, Standard and Industrial Classification Manual, 1972.

Metropolitan Denver Sewage Disposal District, Number 1, Annual Budget, 1972.

MDSDD #1, Annual Budget, 1973.

MDSDD #1, Annual Budget, 1974.

MDSDD #1, Annual Report, 1972.

MDSDD #1, "1972 Loadings and Annual Charges, Final Adjustments."

MDSDD #1, Sewage Treatment and Disposal Agreement (Service Contract), January 1, 1964.

North Table Mountain Water and Sanitation District, Annual Audit Report, by Kennedy and Lesan, C.P.A., November, 1972.

North Table Mountain Water and Sanitation District, Report on Sewage Treatment Charges by MDSDD #1 for the Year 1972, by Rea, Cassens and Associates, Inc., May, 1973.

North Table Mountain Water and Sanitation District, "Sewer Tap Application and Agreement."

North Washington Street Water and Sanitation District, Financial Statements and Accountants' Report, by Clifton, Gunderson and Co., C.P.A., November, 1972.

North Washington Street Water and Sanitation District, Rules, Regulations and Rate Schedules for Water and Sewer Service, and Amendments, May, 1970.

Ritter, L.E., and P.A. Podolick, "Determining an Equitable Surcharge for Industrial Wastes," Public Works, July, 1973.

South Carolina Water Pollution Control Division, Pollution Control Authority, Guidelines for Unit Contributory Loadings to Wastewater Treatment Facilities, 1972.

State Auditory, Office of, Colorado Local Government Accounting, Auditing and Reporting Laws, 1968.

Tenner, Irving, Financial Administration of Municipal Utilities, Public Administration Service, 1947.

Texas Municipal League, Sewer Service in Texas Cities.

U. S. Congress, Federal Water Pollution Control Act Amendments of 1972.

Verlander, F. Michael, and Hoag, Lyle N., "Sewerage: Who Should Pay?", Water and Wastes Engineering, April, 1973.

Virginia Municipal League, Sewer Charges in Virginia Cities, Report No. 493, June, 1968.

Water Pollution Control Federation, "Uniform System of Accounts for Wastewater Utilities," Manual of Practice Number 40.

Water Resources Research Institute, University of North Carolina, Surcharges for Industrial Wastes: Suggestion and Guidelines, 1972.

White, Raymond D., "Determining Utility Rates for Commercial Users," Public Works, May, 1973.

SECTION XII

GLOSSARY

BOD - Biochemical Oxygen Demand, expressed in ppm or tons.

Construction - Any one or more of the following: preliminary planning to determine the feasibility of treatment works, engineering, architectural, legal, fiscal, or economic investigations or studies, surveys, designs, plans, working drawings, specifications, procedures, or other necessary actions, erection, buildings, acquisition, alteration, remodeling, improvement, or extension of treatment works, or the inspection or supervision of any of the foregoing items.

DRCOG - Denver Regional Council of Governments.

EPA - U. S. Environmental Protection Agency

Federal Share - Seventy-five percent of the project cost.

Flow - Amount of sewage directed into or through a system, in gallons.

GPY - Gallons per year.

Industrial Share - That portion of the project cost incurred in constructing publicly owned treatment works allocable to treatment of wastes from industrial users.

Industrial User - Any nongovernmental user of publicly owned treatment works identified in the SIC Manual, 1972 under the following divisions; A,B,D,E, & I if wastes contributed to the system exceed levels for "normal domestic sewage."

Loadings (or system loadings) - Characteristics and components of sewage discharge, usually referring to levels of BOD and SS.

MDSDD #1 - Metropolitan Denver Sewage Disposal District Number 1.

mg - Millions of gallons.

Normal Domestic Sewage - Appropriate or representative parameters for levels of flow, BOD and SS flowing from residential sewer taps. In fact, these levels vary from area to area and district to district. Therefore, what is "normal" for one instance may not be "normal" in another.

NTMD - North Table Mountain Water and Sanitation District.

NWSW&SD - North Washington Street Water and Sanitation District

Preceding page blank

Parameter - Assigned level of flow, BOD or SS based on general average of sampled user classes with similar sewage characteristics.

Plant Investment Fee - Charge levied to users by wastewater agencies to provide for eventual replacement of treatment works.

Pollutant - Dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water.

ppm - Parts per million

ppm to tons (formula) - Tons = concentration in parts per million x 8.345 pounds per million gallons x total flow (mg) ÷ 2,000 pounds per ton.

Project Cost - The cost of construction of publicly owned treatment works as defined in Regulation 40 CFR 35.905-10.

Recovery Period - That period during which that portion of the Federal share attributable to the treatment of industrial wastes is recovered from industrial users.

SIC - Standard Industrial Classification (SIC Manual, 1972, Office of Management and Budget)

SMSA - Standard Metropolitan Statistical Area

SS - Suspended solids, expressed in ppm or tons.

Treatment Works - Any devices and systems used in the storage, treatment, recycling, and reclamation of municipal sewage or industrial wastes of a liquid nature, including intercepting sewers, outfall sewers, sewage collection systems, pumping, power, and other equipment, and their appurtenances; extensions, improvements, remodeling, additions, and alterations thereof; and any works, including site acquisition of the land that will be an integral part of the treatment process or is used for ultimate disposal of residues resulting from such treatment. In addition, treatment works means any other method or system for preventing, abating, reducing, storing, treating, separating, or disposing of municipal waste, including storm water runoff, or industrial waste, including waste in combined storm water and sanitary sewer systems.

Unit Costs - The cost of collection, treatment, and/or disposal of wastewater discharge per unit (pound/ton, gallon/thousand gallons/million gallons) of flow, BOD and SS.

User - An individual subscriber (industry, warehouse, hospital, home, business, etc.) contributing effluent to the sewer system.

User Charge - Charges levied by wastewater agencies to users to cover operating and maintenance costs in proportion to total treatment works loading.

User Class - A group, or category, of users having similar sewage flow and content characteristics.

Wastewater Agency - A public agency, either a numicipality or district, established for the purpose of collecting and/or treating and disposing of wastewater discharge.

WS&A - Wilbur Smith and Associates

APPENDIX A

MODEL ORDINANCE (RESOLUTION)

AN ORDINANCE (RESOLUTION) TO REGULATE, RESTRICT, AND LIMIT, IN THE INTEREST OF THE PUBLIC HEALTH AND SAFETY, THE DEPOSIT OR DISCHARGE OF CERTAIN SUBSTANCES INTO ANY SANITARY SEWER NOW MAINTAINED AND/OR OWNED BY OR WHICH MAY BECOME THE PROPERTY OF THE (CITY) (TOWN) (DISTRICT) OF _____. BE IT ORDAINED BY THE BOARD OF _____ OF THE (CITY) (TOWN) (DISTRICT) OF _____ AS FOLLOWS:

Section 1: DEFINITIONS

1. Sanitary Sewer is a sewer intended to receive domestic sewage and industrial waste, except that of the type expressly prohibited by this ordinance, without the admixture of surface water and storm water.

2. Domestic Sewage is that liquid waste from bath rooms, toilet rooms, kitchens and home laundries.

3. Industrial Wastes are the liquid wastes, other than domestic sewage, resulting from processes or operations employed in industrial establishments.

4. "B.O.D." (Denoting Biochemical Oxygen Demand) shall mean the quantity of oxygen utilized in the biochemical oxidation of organic matter under standard laboratory procedure in 5 days at 20° C, expressed in parts per million by weight.

4. "Properly Shredded Garbage" shall mean the wastes from the preparation, cooling, and dispensing of food that have been shredded to such degree that all particles will be carried freely under the flow conditions normally prevailing in public sewers, with no particle greater than 1/2 inch in any dimension.

6. "Suspended Solids" shall mean solids that either float on the surface of, or are in suspension in water, sewage, or other liquids; and which are removable by laboratory filtering.

7. "pH" shall mean the logarithm of the reciprocal of the concentration of hydrogen ions in grams per liter of solution. A stabilized pH will be considered as a pH which does not change beyond the specified limits when the waste is subjected to aeration. A pH value indicates the degree of acidity or alkalinity.

Preceding page blank

8. Color is the "true color" due to the substances in solution expressed in wave lengths of light.

9. Person is any individual, firm, company, association or corporation.

10. (City) (Town) (District) is the (City) (Town) (District) of _____.

11. Receiving Stream is that body of water, stream or water course receiving the discharge waters from the sewage treatment plant or formed by the waters discharged from the sewage treatment plant.

12. Approving Authority shall be the _____ (as designated by the governing body).

13. "Shall" is mandatory; "May" is permissive.

Section II: USAGE OF MUNICIPAL (DISTRICT) SANITARY SEWERS

1. No person shall discharge or deposit any of the following waste materials into any (City) (Town) (District) sewer:

(a) Any liquid or vapor having a temperature higher than _____.

(b) Any water or waste which may contain more than _____ parts per million, by weight, of fat, oil, or grease, exclusive of soap.

(c) Any flammable or explosive liquid, solid or gas, including, but not limited to gasoline, benzene, naptha, and fuel oil.

(d) Any garbage that has not been properly shredded.

(e) Any ashes, cinders, sand, mud, straw, shavings, metal, glass, rags, feathers, tar, plastics, wood, paunch manure, or other solid or viscous substance capable of causing obstruction to the flow in sewers or other interference with the proper operation of the sewage works.

(f) Any waters or wastes having a stabilized pH lower than _____ or higher than _____, or having any other corrosive property capable of causing damage or hazard to structures, equipment, and personnel of the sewer works.

(g) Any waters or wastes having a Biochemical Oxygen Demand in excess of _____ parts per million (mg./l).

(h) Any waters or wastes containing more than _____ parts per million by weight or suspended solids.

(i) Any concentration of Chloride higher than _____.

(j) Any wastes or waters having an objectional color which is not removable in the existing sewage treatment plant processes.

(k) Any waters or wastes containing a toxic or poisonous substance or any other materials in sufficient quantity to injure or interfere with any sewage treatment process, or constitute a hazard to humans or animals, or create any hazard in the receiving stream at the sewage treatment plant.

(l) Any waters or wastes containing suspended solids of such character and quantity that unusual attention or expense is required to handle such materials at the average sewage treatment plant.

(m) Any noxious or malodorous gas or substance capable of creating a public nuisance.

2. The Approving Authority, without limitation by other sections of this ordinance, may authorize any person to discharge industrial waste of unusual strength or character into the sewers of the _____ under approved conditions or pretreatment. The Approving Authority may prohibit entry of particular industrial wastes into the sanitary sewer whenever such action is necessary to prevent damage to the system or to determine the effects of such wastes on the sewage system.

Section III: STRUCTURES REQUIRED

1. Storage Tanks: In order to equalize flows over a 24-hour period, each person discharging a waste into the (City) (Town) (District) sanitary sewers having a volume in excess of _____ gallons in any one day, shall construct and maintain at his own expense a suitable storage tank. Said tank shall have a capacity of at least 80% of the normal volume of one 24-hour production period of waste and whose outlet to the sewer is controlled by a water works type rate controller, or other approved devices, the setting of which shall be directed by the Approving Authority.

2. Any person discharging industrial wastes into (City) (Town) (District) Sanitary Sewer shall construct and maintain a suitable control manhole, down stream from any treatment, storage, or other approved works, to facilitate observation, measurements and sampling of all wastes including domestic sewage, from the industry. The control manhole shall be constructed at a suitable and satisfactory location and built in a manner approved by the Approving Authority.

Where a storage tank is not required, the control manhole shall be equipped with a permanent type volume measuring device such as a nozzle, or other suitable devices as may be approved by the Approving Authority. The manhole shall be maintained by him so as to be safe, accessible and in proper operating condition at all times.

3. Plans for the construction of said storage tank, control manhole, and controlling devices shall be approved by the Approving Authority prior to the beginning of construction.

Section IV: PERMITS

Any person desiring to deposit or discharge, or who is now depositing or discharging any industrial waste into the sanitary sewers shall make application for the disposal of industrial waste to the Superintendent of the (Water) and (Sewer) Department. The Superintendent of the (Water) and (Sewer) Department shall approve such applications only when evidence is submitted by the applicant that the discharge into the sanitary sewer will comply with all of the regulations of this ordinance.

Section V: OUTSIDE CONNECTIONS

Any person owning or controlling premises located beyond the corporate limits of the (City) (Town) (District) of _____ and desiring to install a plumbing system for the purpose of discharging domestic sewage and/or industrial waste into the sanitary sewers of the (City) (Town) (District) of _____ may do so by complying with the requirements of this ordinance and by paying an additional permit fee and a yearly sewer rental charge to be fixed by the Board of _____.

Section VI: POWERS AND AUTHORITY FOR INSPECTION

The Approving Authority and other duly authorized employees of the (City) (Town) (District) bearing proper credentials and identifications, shall be permitted to enter upon all properties for the purpose of inspection, observation, measurement, sampling, and testing, in accordance with the provisions of this ordinance.

Section VII: MEASUREMENT OF FLOW

1. The volume of flow used in computing waste surcharges shall be based upon metered water consumption as shown in the records of meter reading maintained by the (City) (Town) (District) Water Department. In the event that a person discharging wastes into the sanitary sewer system produces evidence to the Approving Authority that part[1] of his water used does not reach the (City) (Town) (District) sanitary sewer, the user may apply to the Approving Authority for a reduced percentage of total water consumption to be used in computing sewer charges.

Where the person discharging industrial wastes into the sanitary sewers of the (City) (Town) (District) of _____, all or part of which is discharged into the sanitary sewer, the person discharging said waste shall install and maintain, at his expense, water meters of a type approved by the Approving Authority for the purpose of determining the proper volume of flow being charged. The Approving Authority has a right to read such private meters.

Section VIII: DETERMINING OF CHARACTER AND CONCENTRATION OF WASTES

1. The Approving Authority or an assistant designated by it shall make a periodic determination of character and concentration of wastes as may be deemed necessary by the Approving Authority.

2. Location and design of sampling sites should be approved by the Approving Authority.

3. Samples shall be collected in such a manner

---

(1) This might be done only if the user presents evidence that more than a certain percent of his water is involved, (i.e., 10 percent).

as to be satisfactory to the Approving Authority. The laboratory methods used in the examination of said waste-waters shall be in accordance with Federal guidelines establishing test procedures as set forth in the Federal Register, Volume 38, No. 199, dated October 16, 1973.

Section XI: PROTECTION FROM DAMAGES

It shall be considered a misdemeanor to maliciously, willfully or negligently break, damage, destroy, uncover, deface or tamper with any equipment or materials belonging to the (City) (Town) (District) of _____ used for the purpose of making tests or examinations and left upon the premises of a person discharging wastes into the sewers.

Section XII: REPEALING CLAUSE

All ordinances (resolutions) or parts of ordinances (resolutions) in conflict with this ordinance are hereby repealed. If any section, paragraph, subdivision, clause or provision of this ordinance shall be adjudged invalid, such adjudication shall apply only to such section, paragraph, subdivision, clause or provision so adjudged, and the remainder of this ordinance shall be deemed valid and effective.

Section XIII: EFFECTIVE DATE

This ordinance (resolution) shall take effect and be in full force from and after the _____ day of _____, 19____.

ATTEST:

_____
(Mayor)

_____
(City) (Town) (District) Clerk

APPROVED AS TO FORM:

_____
(City) (Town) (District) Clerk

U.S. GOVERNMENT PRINTING OFFICE: 1974 — 780-869 / 83 REGION NO. 8